IRD Mechanalysis® Limited

The Vibration People®

Vibration Diagnostic SmartMeter model IRD449

Operation & Maintenance Manual

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Customer Details	
Date Purchased:	
IRD Serial Number (s):	
P.O. ref:	
Organisation:	
End User:	
Next Calibration Due:	

IRD Mechanalysis Limited

www.irdmechanalysis.com

IRD Mechanalysis® Limited continues to be the industry leading provider of Condition Management Solutions. With 35 years' experience in machinery vibration and associated condition monitoring technologies, the company designs and manufactures proven instrumentation suitable for rugged industrial environments. A comprehensive range of products and services are available from the offices below.

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1. Why perform vibration diagnostics

Vibration diagnostic allows checking the condition of all your machinery. You will be informed early about potential failure before the machine gets damaged and you will be able to order only real specific required maintenance (instead of expensive overhauls). The periodical measurements will allow you to keep your machines in good health.

2. Why IRD449 Vibration Diagnostic SmartMeter (VDSM)?

You always ask before you make a decision to buy the new instruments what unit is the best for your needs. Is it an instrument with a large amount of functions, including specialized software for data processing (which you will not ever use), or is it an instrument which is easier to use and contains all required functions? You should pay only for functions, which you will use in the field. The IRD449 is just that instrument. The instrument uses standard external accelerometer with the magnetic base. It enables correct repeatable measurements. You should not equate our unit with "vibration pens".

The IRD Mechanalysis model IRD449 is a multi-function portable meter that bridges the gap between the basic and advanced FFT data collector/ analyser. It is a complete machine condition expert system than gives results without the use of a computer or lap top. It is designed for the technician, engineer and consultant who need to analyse a rotating machine on-site without investing and carrying expensive instruments to site.

This single meter undertakes overall vibration measurement, three band spectrum, 200lines spectrum, Time Wave Form, temperature, tacho for speed, strobe scope. In addition it incorporates a handy inspection torch.

The IRD449 caters to ISO 10816-3 with expert rules covering machine health vibration levels: that identify the prime machinery faults: Unbalance, Looseness and Alignment. An anti-friction bearing health level indication is also incorporated. Many informative screens are available.

Do your machines work under optimum conditions? The IRD449 will:
- Determines the condition of your bearings, including slow-running ones.
- Identify insufficiently lubricated bearings.
- Indicates unbalance, looseness, misalignment.
- Check unbalance, alignment and loose foot
- Check machine speed by built-in stroboscope.
- Check machine temperature by Non-contact temperature meter.
- Measures in either Metric or English units.

Operation of IRD449 is easy to use. Colours green, orange and red display the status. Determination of individual machine or bearings defect types is done directly during operation, without need of use a computer or software. Despite the IRD449 is very compact and rugged, it is designed and fits in the palm of a small hand. Nevertheless the IRD449 is big in performance.

The IRD449 is supplied complete set with an accelerometer, coiled cable, magnetic base, transit case and earphones. You can connect earphones to listen to machinery noise related to vibration and process. When measuring transmissions or slow-running bearings, you will quickly appreciate the benefits of the earphone accessory.

3. Vibration Diagnostics - Basic Information

3.1 Introduction

What is it the vibration diagnostics? This chapter explains the basic steps and you will be able to begin practical measurements. More information you can find in the literature.

When we are talking about the vibration diagnostics, we mean regular measurements (usually every 2-4 weeks), whose objectives primarily are:

1. Finding of change of vibration level, it means change of machine operational condition.
2. Determining reason of this change.
3. Recommending maintenance (repair, adjustment, lubrication etc.).
4. Checking of maintenance success (including revision of dismantled part to confirm the analysis).

The machine vibration diagnostics solves two basic tasks:

1. Diagnostics of machine mechanical failure (imbalance, misalignment, mechanical looseness etc.).
2. Diagnostics of rolling bearing condition.

3.2 Basic Rules

1. If the measured value of vibration increases in time, it is a change indicator - worsening of the machine condition.

2. If the measured values do not change, the machine works in stable operation condition.
This doesn't necessarily mean good condition. For example if a bearing was installed incorrectly, then there will be high signal value immediately. This value will remain stable for some time (the bearing will be able to withstand it), but then there will be a fast increase and destruction of the bearing. This short bearing life can take hours, days, weeks or even months.

3. Reliability of the diagnostics will never be 100%.
There will always be defects, which develop in time shorter than regular measurements. The defects caused by material fatigue can develop in several seconds only (cracks, breaks). The proof of the diagnostic performance is primarily a decrease in maintenance costs (not to absolute zero) and a significant decrease in unexpected breakdowns (not their complete elimination).

4. Using of standards is possible only with special machines, for which the special standards exist.
It is not possible to simply define limit vibration values in general for a wide range of machines. However, it is possible to create the standards for special machines (e.g. turbines), and these standards are a strong diagnostic tool. General standards have a character of recommendation on how to define the limit values. The way how to find the good condition values is to use measured values of new or repaired machine. Also you can ask the machine producer for them.

5. Shortening of an interval between measurements means more successful prevention of unexpected failures.

3.3 Machine and bearing condition diagnostics

Basic defects which we'd like to find out are
- Unbalance (heavy spot on the rotor causes vibrations),
- Misalignment (machinery parts are not in alignment),
- Looseness (machine is not properly connected with its base - soft foot),
- bearing defect (wear of bearing, bad assembly, bad lubrication or overload).

First three defects influence the whole machine (e.g. the vibration caused by unbalance we can take from any point on the machine). We use the vibration velocity [mm/s] measurements for that.

Roller (ball) bearing condition we can detect only on the nearest point. This is the local failure. We measure always vibration acceleration only [g].

3.4 Methods for ball bearing condition diagnostics

We can find out several methods for bearing condition detection in literature. We should repeat again:

We have to measure vibration acceleration in [g] for correct data acquisition. All methods must satisfy the conditions.

We can choose different procedures for evaluation of the acceleration signal. Measured signal can be imagined as a level of the river. It flows with appropriate speed and there are little or big waves. If we want to measure the stream we can measure the flow per hour or prompt wave's level. The value of the flow will be stable and it will change slowly. But the wave's levels are unstable because measurements have significant variety of values.
The similar effects occur for bearing condition measurements. You can measure RMS value (the total energy in signal) or PEAK value (the highest peak in signal). We can use both types for evaluation, just have to realize of advantages and disadvantages.

RMS measurement
- **advantages** - stable and well repeatable, time trends are well readable
- **disadvantages** - if wear increases the response is slower then PEAK, but sufficient for maintenance.

PEAK measurement
- **Advantages** - fast response for any condition change.
- **Disadvantages** - not stable and well repeatable (extremely sensitive), time trends are not well readable.

From these two basic measurements further measurements are derived:
- **g_{ENV}** - envelope signal modulation. Advantages and disadvantages are in the middle of RMS and PEAK measurements.

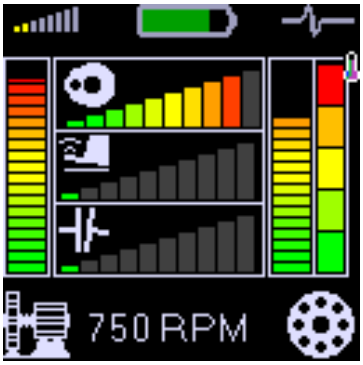
- **g_{SE} BCU, SEE, SPM** - measurements are performed usually on the sensor resonance frequency. These methods have the same advantages and disadvantages like the PEAK measurement.

3.5 The relation between gears and ball bearings

For gearboxes diagnose it is also necessary to measure acceleration signal like for ball bearings. When the balls are rolling over the damage tracks (pitting), the shock pulses occur in signal. Unfortunately similar shocks are also in signal from on worn or damaged gears. So if we measure gearbox with roller bearings then higher vibration values can be caused by both sources.
More information for this kind of analysis you can find in chapter Vibrations in frequency range - gearboxes/bearings.

3.6 Fault Source Identification and Diagnostics Tool

This tool is included in the IRD Mechanalysis IRD449 VDSM. It is good message for users, because such function has never been built in the instrument in this price category. This function displays several bar graphs with traffic light colours. Two major (largest) bars are allocated to general machine condition (on the left side) and ball bearing condition (on the right side).



The next three bars are located in the middle. They display the severity level of UNBALANCE, LOOSENES and MISALIGNMENT (from the top).

3.7 Measurement Points

The measurement location must enable repeatable measurements under the same conditions as the previous measurement. Also the direction of sensor (radial, axial for rotated machines) is important.

That is why you should determine measurement points on the machine. The typical machine together with the measurement points are shown in Figure1.

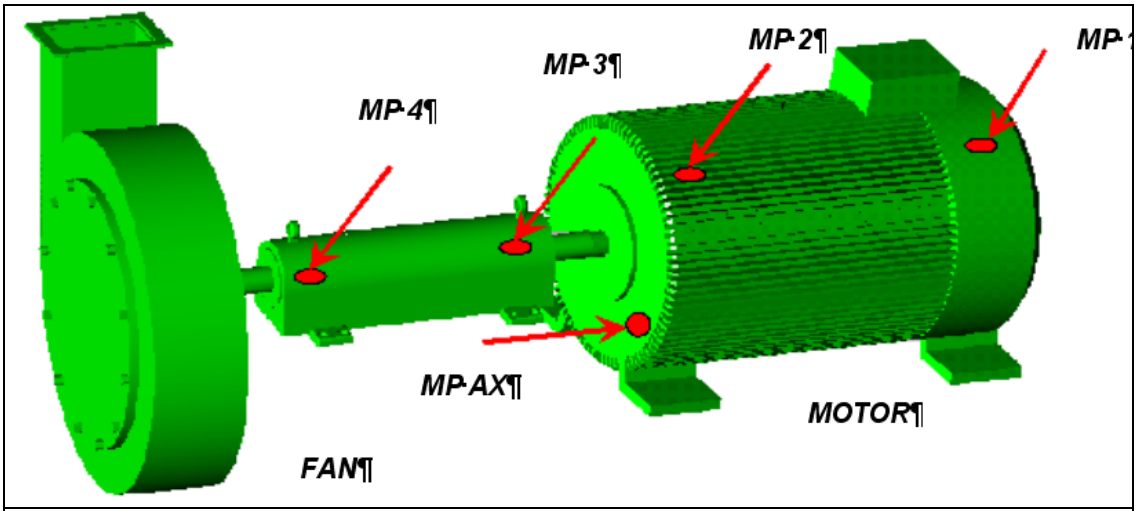


Figure 1 Typical measurement points on a rotating machine

For the measurement in radial direction, we are going to place the sensor perpendicularly to the axis of rotation, for axial measurement along the axis. The radial measurement can be usually performed horizontally, vertically or in another angle. The importance of the angle choice should not be overstressed; choose any radial direction with easy access.

The measurement points need to be prepared for the measurements. The best is to place measuring pads on a machine (see the chapter Preparation of Measuring Location).

3.8 The preparation of the measurement point

On the measurement point we make a measurement. To obtain a quality measurement, the points for measurements must be prepared in advance. For regular measurements the sensor must be

always fixed in the same way at the same point. For diagnostics of bearings it is necessary to fix the sensor with a magnetic base. Do not push the sensor only by hand - high frequencies cannot be measured in this way.

The magnetic base is firmly screwed to the sensor and then it is magnetically fixed to the metal surface of the machine. Hence the sensor is fixed and a measurement is possible. Quality of fixation markedly influences the result of your measurement. If the sensor swings or jumps about etc., your measurement is pointless. A layer of paint is also a big obstacle for higher frequencies. The magnetic base has ground surface and the same surface quality must be created on the machine. In practice, it is not possible. A flat surface 3x3 cm in size can be ground only in a workshop. Anyway, quality of the bearing's housing steel is not high and such a surface can quickly succumb to corrosion. Then it becomes unusable.

Solution to this problem is to use measurement pads. These are the cylinders with the diameter approx. 26 mm and height 10 mm with a ground surface, made of a magnetic stainless steel. They are fixed to chosen points with special glue, which ensures a perfect transmission of the high frequency vibrations. The pad is covered with a plastic cover, which is removed only for the measurement. Another advantage of the cover is that when the machine is painted, your measurement point is preserved. The paint would devalue the pad. It is sufficient to coarsely grind the machine's surface and degrease it before the pad is glued. Durability of the pads in time is unlimited. In practice, it is always until a forcible removal.

You will need mainly the following aids: angle grinder, set of files, sand paper, degreaser (ethanol, solvent), measurement pads and glue.
Prepare the surface in the following way:
- remove the paint, corrosion or unevenness from the surface by grinding,
- degrease the surface.

The pad is being fixed on measurement point with the glue. We usually use the METAL TECH SG cement, also other glues with similar properties may be used.

The METAL TECH SG cement is a 2-component epoxy cement with properties best suited for this task. The two components, after mechanical mixing, chemically react and after drying they form a hard material resistant to pressure, temperature and humidity.

In the case of the simple pad the procedure is as follows: cut-off a disc approx.3 mm thick from the cement with a sharp knife. Wet your fingers and work the disc into a homogenous lump. Roll a cylinder with the diameter approx. 2-3 mm from this lump and put it on the side, which is not

roughened.

Push the pad with glue to the prepared place and, while constantly pushing and turning the pad there and back with circular movements, observe that the cement is being evenly pushed out along the circumference of the pad. The purpose is to make the layer between the pad and the surface as thin as possible.

ATTENTION

CEMENT MUST NOT BE PUSHED OUT COMPLETELY!

Pushed out cement may be removed or levelled out around the pad. In the end you put a cover on the pad. When using the **T** pad, amount of the cement is dependent on the size of the gap between the motor ribs and it is not so easy to determine amount of the cement to process. As with the simple pad, the surface between the ribs must be well cleaned and degreased. The space shall be filled with the necessary amount of the cement so that only the cylindrical part of the pad remains visible after drying of the cement. In the end put the cover on the pad.

3.9 Listening to Vibrations Using Headphones

A user can connect headphone to the IRD449 – Vibration Diagnostic SmartMeter instrument, since listening to a measurement signal also enables a differentiation of a problem type. People can think that this is an old method, which does not have a place in this modern world. The opposite is true. Analysis of gears and low speed bearings (e.g. in paper mills) gain better quality by using the listening method. The listening can easily be done by any maintenance person without deeper knowledge of diagnostics. If there is a defective bearing, distinct rumbling sound is audible in the earphones then. If the bearing is OK, then you can hear only a weak noise.

HEADPHONE WARNING

Listen at moderate volumes to avoid hearing damage. Always remove the headphone from the ears when you move the sensor or re-connect cable.

3.10 Relationship of Measuring in Acceleration and Speed

Maintenance staff usually measure vibrations in mm/s or inch/s (velocity) only and not vibrations in g = 9.81 m/s^2 (acceleration). This is a relic of the past, when old equipment enabled the vibration speed measurement only. Bearing defects are not recognizable by using velocity measurements. If the velocity value increases due to a bearing defect, then the defect is already serious and there is an acute danger of unexpected breakdown. The measuring of the velocity vibration does not give early enough warning before failure of a rolling bearing.

NOTE:
For accurate bearing condition measurement you have to measure the acceleration vibration!

3.11 Abbreviations used in the manual

RPM – Revolutions per minute
CPS – Revolutions per second
RMS – RMS value of the measured signal
PEAK – Peak value of the measured signal

4. What Will You Get with Your Instrument

4.1 Instrument and accessories

The instrument package consists of the following standard accessories:

SNo.	ITEM	PART NO.	Qty
1.	Sensor Accelerometer, model IRD511, Standard, 2-10KHz, 100mV/g, Top Exit, Mil 2 Pin, 1/4"-28UNF Female Mounting Thread with National Traceable Cal. Cert.	M5111005001000	1
2.	Cable Assembly Coiled, for model IRD944/ IRD449 Binder to accelerometer Mil spec 2-Pin connector, expandable to 1.6m	M60164	1
3,	Headphones	M91208	1
4.	Magnetic Portable Base, IRD500 Series Accels	M24828	1
5.	Carrying Case for model IRD449	M25352	1
6.	Manual Operating instructions in English and CD	M44999	1

The standard package for IRD449 consisting of the meter, cable, sensor, headphones, Carrying Case & manual is depicted in Figure 2.

Figure 2 IRD449 – Vibration Diagnostic SmartMeter with standard accessories

5. Before You Start

Ignoring any of the recommendations mentioned below may cause failure of the instrument.

Handling voltage higher then +24 VDC can cause an accident.

1. Always connect only ICP type sensors into an ICP marked socket! If unsure, consult the procedure with your supplier.

2. Never plug this instrument into 230 V household voltage!

3. To power this instrument, use batteries with max. nominal voltage of 1.5 V!

4. To power this instrument, use only alkaline or rechargeable (NiCd, NiMH) batteries. Regular carbon-zinc batteries are not suitable.

Use correct battery polarity.
Incorrect polarity will cause destruction of the instrument!

HEADPHONES WARNING!
Listen at moderate volumes to avoid hearing damage.
Remove the earphones from the ears when you move the sensor or re-connect cable.

6. Standards for vibration measurements

Vibration measurements without a standard for comparison are seldom of any use. There needs to be some guide to show how much is too much. Table 1, provides a guide for Machine Tool Vibrations. The values listed merely indicate the range in which satisfactory parts have been produced. Actual tolerances must be determined by your own experience as to what vibration levels permit the meeting size and finish tolerance.

Table 1 Tentative guide to vibration tolerances for machine tools

Type of machine	**Displacement of vibration as read with sensor spindle bearing housing in the direction of cut**
Grinders	**Tolerance Range**
Thread Grinder	0.25 - 1.5 microns
Profile or contour Grinder	0.75 - 2.0 microns
Cylindrical Grinder	0.75 - 2.5 microns
Surface Grinder (Vertical Reading)	0.75 - 5.0 microns
Gardner or Besly type	1.25 - 5.0 microns
Centreless	1.0 - 2.5 microns
Boring Mill	1.5 - 2.5 microns
Lathe	5.0 - 2.5 microns

These values come from the experience of IRD personnel who have been trouble shooting machine tools for over 10 years with the IRD equipment. They merely indicate the range in which satisfactory parts have been produced and will vary depending upon size and finish tolerance.

NOTE:
The above tolerance ranges consist of machine vibration displacement values at which acceptable parts can generally be produced and are supplied as a guide for judging the indicated vibration as a warning of impending trouble. The measurements were obtained with the vibration sensor mounted on the spindle bearing housing in the direction of the machine cutting.

The units in which vibration severity may be measurement displacement, velocity or acceleration – are interrelated to one another. Displacement is used for measuring the condition of slower speed machinery, particularly where displacement standards have been established or where excessive unbalance is present. However, Velocity measurements provide a measure of the combined effects of vibration frequency as well as displacement and can be universally applied regardless of machine speed or type of trouble. This type of measurement provides a direct indication of the vibration severity and is generally the best indicator of the machine balance or condition. Acceleration is generally used when vibration occurs at high frequencies and often where the frequency of the source is many times the shaft RPM.

The vibration amplitude should be obtained in velocity and in whatever other units are desired. Measurements in displacement or acceleration will provide an indication of the vibration severity only if the dominant frequency of the machine vibration is known. Since the vibration velocity is consistent with rotational speed, vibration severity measured in terms of vibration velocity is most common. One such machine vibration severity chart is tabulated in Table 2A for general machines and in Table 2B for large machines.

Table 2A General Machinery Vibration Severity Chart (metric) for Medium and Large Industrial Machines

Vibration Severity Guidelines for Medium & Large Industrial Machines - Ref: ISO 10816-3				
Vibration Velocity mm/sec RMS	Group 2 Medium Size Machines		Group 1 Large Size Machines	
	Rated Power			
	15 KW to 300KW Shaft height 160mm-315mm Generally with Antifriction Bearings		300KW to 50 MW Shaft height >315mm Generally with Sleeve Bearings	
11		DAMAGE MAY OCCUR		
7.1				
4.5		SHORT TERM OPERATION		
3.5		CONTINUOUS LONG OPERATION		
2.8				
2.3				
1.4		NEWLY PUT INTO OPERATION		
0.71				
Foundation	Rigid	Flexible	Rigid	Flexible

Table 2B A general machinery vibration severity chart (metric) for General Machines.

Vibration Severity Guidelines for General Machines - Ref: ISO10816-1				
Vibration Velocity mm/sec RMS	Class I Small Machines (< 15 KW)	Class II Medium Machines 15KW to 75 KW	Class III Large Machines (> 75KW) Rigid Foundation	Class IV Large Machine (>75KW) Flexible Foundation
0.28			GOOD	
0.45				
0.71				
1.12				
1.80				
2.80			ACCEPTABLE	
4.50				
7.10			TOLERABLE	
11.20				
18.00			UNACCEPTABLE	
28.00				
45.90				

6.1 Setting Vibration Limits in IRD449 VDSM

It's possible to set up these values directly in the unit. Then the measured values are displayed in traffic light colours. You can choose IRD Mechanalysis limits (recommended) or ISO10816 limits tabulated in Table 2A & 2B. Setting up is in menu under the mode SETUP (see instrument operation).

Coloured marks according to ISO10816 are ranges A and B, displayed by green colour. Range C is amber and range D is red. This is tabulated in Table 3A and Table 3B for machine groups 1&3 and 2&4 respectively. It's necessary to choose a type of evaluation R13, F13, R24 or F24.

Table 3A Classification of vibration values for machines groups 1 and 3

Foundation class	**RMS velocity values**		**Border Zone**
	mm/s	*in/s*	
Rigid (R13)	**2.3**	**0.09**	**A/B**
	4.5	**0.18**	**B/C**
	7.1	**0.28**	**C/D**
Flexible (F13)	**3.5**	**0.14**	**A/B**
	7.1	**0.28**	**B/C**
	11.0	**0.43**	**C/D**

Table 3B Classification of vibration values for machines groups 2 and 4

Foundation class	**RMS velocity values**		**Border Zone**
	mm/s	*in/s*	
Rigid (R13)	**2.3**	**0.09**	**A/B**
	4.5	**0.18**	**B/C**
	7.1	**0.28**	**C/D**
Flexible (F13)	**3.5**	**0.14**	**A/B**
	7.1	**0.28**	**B/C**
	11.0	**0.43**	**C/D**

6.2 Dominant Frequency

It is sometimes useful to know the Dominant Frequency of Vibration of a machine that has several rotating parts, consider, for example, a belt driven blower. The dominant frequency will reveal which part of the machine is causing the most vibration. Vibration measurements taken with the Model IRD306DI are overall vibration readings or the vector sum if all the vibration at the point the sensor is applied. Measurements taken on the motor bearings would include vibrations of the motor plus vibration from the pump transmitted through the gear box and mounting structure. Conversely, measurements taken on the pump bearings would include vibrations of the gear box plus vibrations transmitted from the motor (See Figure 3). In many cases the point with the most vibration would pinpoint which part has the trouble, but not always.

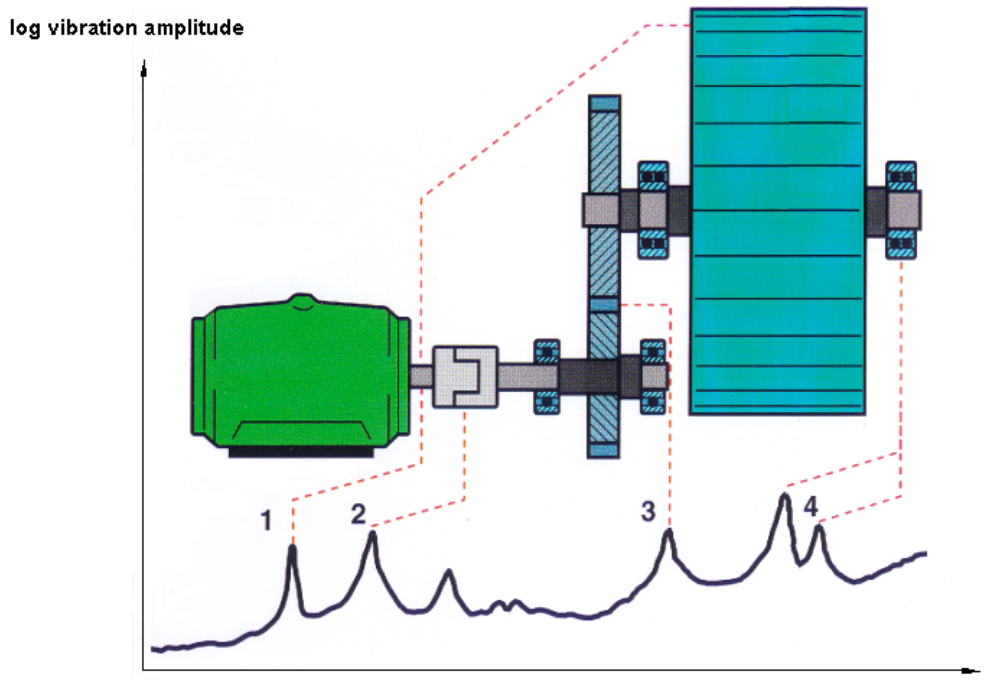


Figure 3 Discrete machine frequencies show different defects

The Figure 3 can be used to find the dominant frequency of vibration provided the readings taken are steady, i.e. the readings do not fluctuate more than 10%.

Use the following sequence to find the dominant frequency.

1. Measure and record the displacement (D) at a given point.
2. In the same manner and at the same point, measure and record the velocity (V)

Be sure to use the exact same measuring point holding the sensor steady for both the displacement and velocity readings.

3. The Dominant Frequency can be found by dividing the velocity measurement (V) by the Displacement Measurement (D) and multiply by the constant 19,120. The answer will be the Dominant Frequency of Vibration is cycles per minute.

$$\text{Dominant Frequency (CPM)} = \frac{\text{Velocity V (millimeters/second} \times 19.120 \text{ (Metric units)}}{\text{Displacement (D) micrometers}}$$

For example, in Figure 3, the motor runs at 1,750 RPM and the fan at 2,60

For example, in Figure 3, the let us assume motor runs at 1750 RPM and the pump at 5250 PM. If the measurements taken on the motor are: displacement (D) = 24 microns and velocity (V) = 6.59 mm/s. Then the dominant frequency is:

$\frac{(V)\ 6.59}{(D)\ 24} \times 19{,}120 = 5{,}250$ CPM

This is equal to the pump speed. Thus the pump is the dominant part and is causing the largest vibration.

Generally the dominant frequency will be equal to the rotating speed of the part causing the vibration, assuming that the trouble is unbalance. In any event the dominant vibrating frequency will normally be some multiple of RPM of the part. After determining the dominant frequency, the type of machine fault present may be assumed from the following table2.

Table 3 Dominant machine excitation frequencies and most likely causes

DOMINANT FREQUENCY	MOST LIKELY TROUBLE
1 X RPM	Unbalance and / or misalignment If axial vibration is large Check for bent shaft or Misalignment
2 X RPM	Looseness, misalignment
3XRPM	Misalignment
Many times RPM	Bad roller or ball bearings or gears
Less than 1XRPM	Oil whirl (Less than ½ RPM)
Synchronous (AC Line frequency)	Electrical problems
2X Synch. Frequency	Torque pulses
Many times RPM (Harmonically related)	Bad gears Aerodynamic forces Hydraulic forces Mechanical looseness Reciprocating forces
High frequency (Not harmonically related)	Suspect antifriction bearings

NOTE: This table is just a guideline for root cause analysis of a machine problem. There are many other causes of vibration not listed. To pinpoint all but the simplest requires a thorough analysis and interpretation of the vibration patterns of a machine using a IRD Vibration Analyser.
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7. Quick Start

The aim of this chapter is to introduce you this instrument, and, without reading a complete User's Guide, enable you to measure first vibration values. This chapter does not describe full and detailed operation of this instrument or measurement methodology. Special chapters in this Guide are intended for this purpose.

7.1 Preparation of Measurement Point

We have to select a measurement point before the measurement itself. We want to choose it in such way that transmission of vibrations would not be attenuated. Usually this means as close to the source of vibrations as possible (for instance at a bearing housing). We always have to measure at solid, firm part of a machine. We should not be measuring on covers and so on. The place should be clean, without corrosion and paint. It should also be flat so a sensor would not "wobble". The best is to use a measurement base, which is glued on a machine. It has a perfect surface, plastic cover, and is made from magnetic stainless steel. This will enable you to perform the measurements on the machine at any time under the same conditions. Measurement repeatability means that you will be able to compare values well.

7.2 Putting in Batteries

Batteries are accessible after opening a lid at a bottom part of the instrument. Open the lid by pressing its lower edge (the edge with hinge), the lid upper part opens easily - see Figure 4B. Do not ever use force! Proper polarity is shown in Figure 4C

Do not forget to switch the instrument off before opening the power battery lid!
Never handle the power batteries with the instrument switched on!

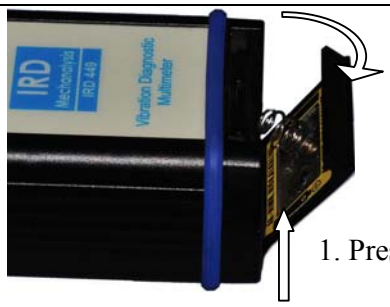


Figure 4A Opening of the lid

Figure 4B Placement of power batteries

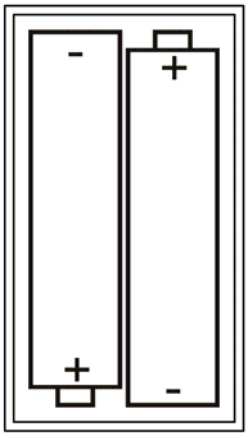


Figure 4C Proper cell polarity

7.3 Plugging in Vibration Sensor

To measure a vibration signal we need to plug in the vibration sensor with ***ICP*** power. The plugged in sensor must be a standard ***accelerometer with 100 mV/g sensitivity***. The instrument is equipped by its own source of ICP power for connected sensor. The sensor needs to be connected at the right input plug by a supplied cable. Figure 5 depicts the instrument connected by a coiled cable to the sensor.

Figure 5 The instrument with a sensor connected

The headphones output is on the left (3.5mm jack). The accelerometer input is on the right side. The contact-less temperature sensor is on the bottom. Four LEDs of strobo are in the top of panel. This is depicted in Figure 6

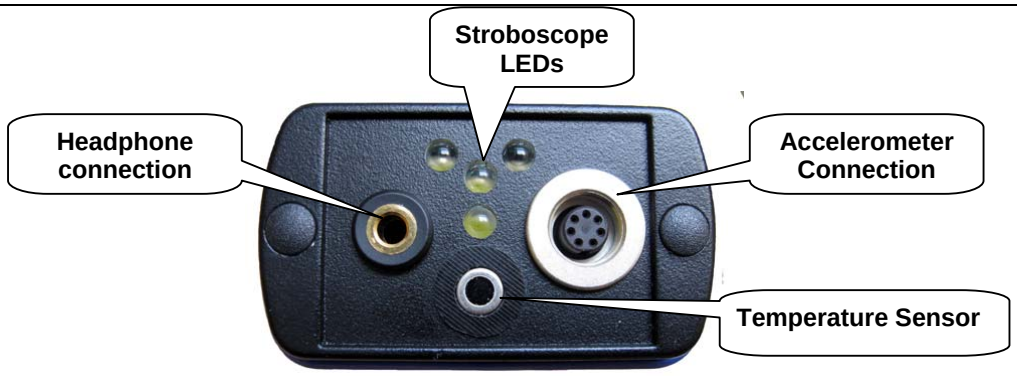


Figure 6 The instrument with a sensor connected

7.4 Vibration Measurements

Screw the sensor onto the magnetic base. Do not forget to remove the plastic cover and a metal washer (it closes a magnetic field for longer service life of the magnet) before measuring. Place the plastic cover and the metal washer back on the magnet after measuring.

Place the magnet on a measuring point very carefully. Best is to rest the edge of the magnet on its side and then slowly lower the sensor onto a machine. If you bring the magnet near to the machine with its whole area hitting the machine all of the sudden, then the strong impact can irreversibly destroy the sensor.

In case you use a measuring tip instead of the magnet, measured values are not going to be stable. This in not surprising. The measured values depend to a large extent on a pressure of the tip at the measurement point. The magnet that attaches the sensor generates a constant pressure so the values are stable.

ATTENTION

Use the measuring tip only in hard to reach places, where it is not possible to place the magnetic base

7.5 Temperature Measurement

Infrared sensor for temperature measurement is aside from accelerometer input. Measurement angle is about 45 degrees around the sensor centre axis. Best results are taken with sensor distance 10-20 cm from measured surface. The relation of the sensors sensitivity Vs. the angle is shown in Figure 7A along with the size of the scanned area Vs. distance shown in Figure 7B. The accuracy of result depends of emissivity; this is typical property of IR temperature sensors.

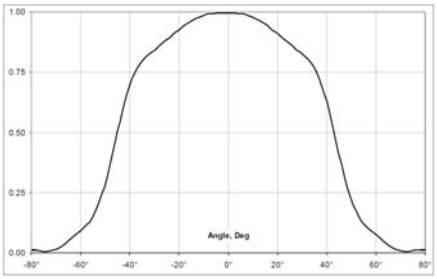


Fig 7A. Sensor sensitivity vs. the angle

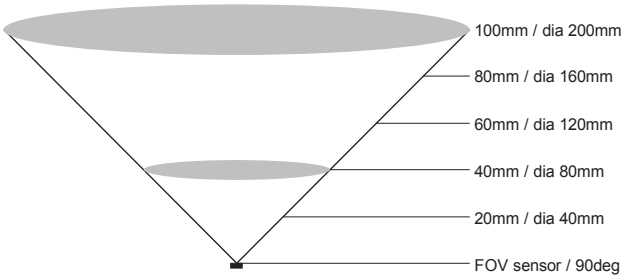


Fig 7B. The size of the scanned area vs. distance

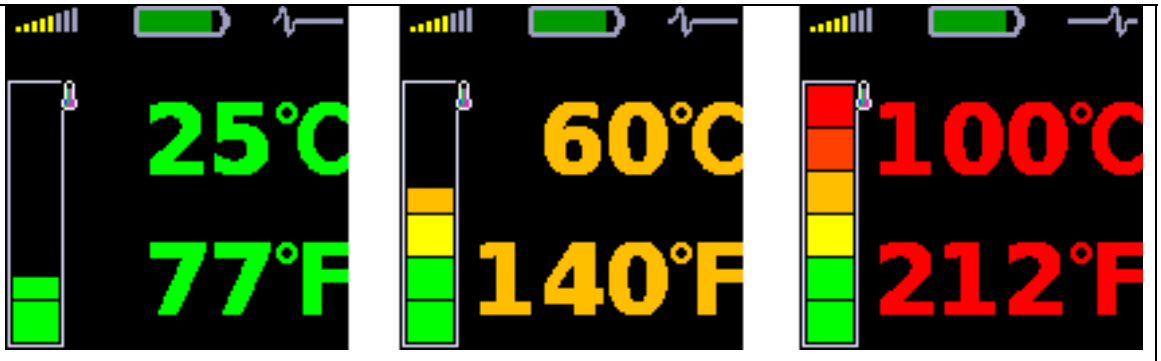


Figure 8 The temperature measurement zones in IRD449

Measured temperature is displayed in Celsius and Fahrenheit degrees. Also the coloured bar is used. The bearing symbol on the other displays is also coloured according to the actual temperature value. The ranges of colours are for less then 30°C - green, 30-45°C - yellow, 45-60°C - orange, 60-75°C - red and for greater then 75°C – dark red. A typical case is depicted in Figure 8.

7.6 Automatic detection of the machine speed

It's important to know the speed for evaluation of the machine condition. Instrument is looking for speed in the frequency spectrum (200Hz range).It is assumed that most of the vibration energy is located on the speed frequency. If the instrument finds significant energy level on one frequency (that means in very narrow band) then this frequency is labelled as the speed frequency. From this description is clear that the speed has not to be found always. If the higher level of energy is located in the spectrum on other line then speed frequency (for example frequency of the fan blades), then the wrong result can be displayed. However the correct speed, which must be defined for condition levels, can be entered manually as well..

7.7 Evaluation of the machine and bearing conditions

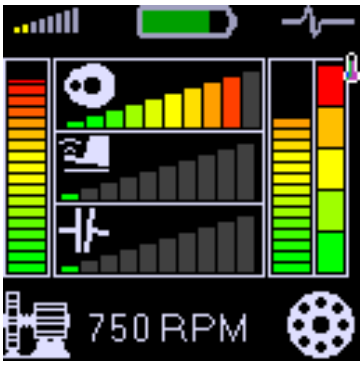
Diagnostician is always asking a basic question after measurement: "What condition of the machine should I assign to this measured value?"

Machine conditions are divided into 3 levels, which have the same colours like traffic lights:
1. GOOD – GREEN COLOR
Machine is in good condition, no defect is found. The operation is without restrictions.
2. ALERT - AMBER COLOR
The beginning defect has been found on the machine. It is possible to operate with paying more attention and planning of repair.
3. DANGER – RED COLOR
Serious defect has been found on the machine. Machine shouldn't be in operation.

Special functions are included in the instrument for detection of that three states. The overall vibration values are coloured with appropriate colour. The vibration limits **IRD Mechanalysis** for each state are determined from the graphs, which are printed in the **IRD Mechanalysis Limit Values of Machine and Bearing Vibrations** chapter.

7.8 Fault Source Identification and Diagnostics Tool

Press the left arrow on the screen No.1 and the Fault Source Identification and Diagnostics screen appears. For correct evaluation the speed must be defined. The instrument can do it automatically or by user manual entry.



In the left bottom corner you see the Machine icon. The vertical bar displays the general (overall) machine condition. This condition can be evocated by many reasons. The unit evaluates the severity of 3 sources, which are the most occurred in the practice:
- Unbalance (circle with heavy spot icon),
- Looseness (shoe icon),
- Misalignment (clutch icon).

Correspondent faults horizontal bars are in middle. On the right bottom corner you find the rolling bearing icon. The vertical bar displays the bearing condition.

7.9 The Stroboscope

The build-in stroboscope inside the IRD449 VDSM represents the unique innovation in the handheld vibration analyzer field. We use the high lighting LED technology, which low power consumption enables to use the stroboscope in our instrument.

Stroboscope or stroboscopic lamp, commonly called a strobe, is the device which produces regular flashes of light. When we have to study or to visually inspect the machinery, which have cyclically moving parts, then the stroboscope enables to froze the moving (usually rotation). Imagine the simplest form, a rotating disc with one-spaced hole. When the flashes of light are synchronized with the rotational speed of the disc, then just one flash is made during one rotation. It means, the disc is lightened up when the hole is always in the same position. It is the principle of illusion of frozen movement. A typical measurement is shown in Figure 9..

Figure 9 The Stroboscope measurement employing IRD449

7.10 The Torch

You sometimes need to inspect or read the dark corners. In that time you are lucky with IRD449 VDSM, because this instrument has built-in torch in front panel. Please refer Figure 10.

Figure 10 The IRD449 Torch operation

8. INSTRUMENT OPERATION

8.1 Switching on and off

The instrument is switched on by pressing of the middle button ⏻ (shown in Figure 11)

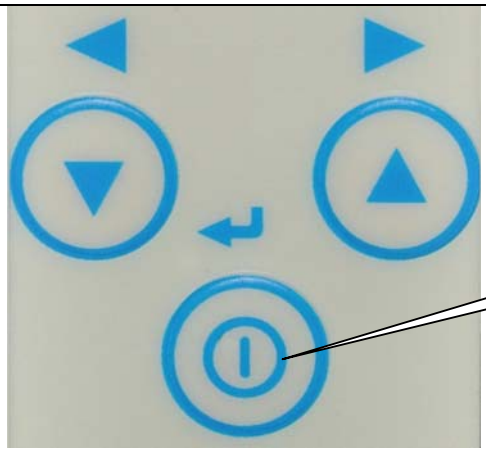


Figure 11 IRD449 Power ON

Provided that batteries with sufficient voltage are placed in the instrument then a display will show an instrument Logo. If the batteries are weak the IRD449 sign is bordered in red (Please refer Figures 12A, 12B & 12C)

Fig 12A Switching on Figure 12 IRD449 Power ON

Fig 12B Switching off

Fig 12C Switching on with weak batteries

Description of numbers in initial screen:

1. The sensor sensitivity mV/g times 10 (983 means 98,3mV/g)
2. Firmware version (V2.05dtH)
3. HP filter frequency for bearing in kHz (0,5 kHz)

The instrument is **switched off** by pressing and holding the same button ⏻ for a longer time. The POWER OFF appears on the display. Release the button and the instrument switches off.

8.2 Standby Mode

When the user does not press any button for 10 minutes, the instrument changes the standard run mode to the Stand by mode - the screen is darkened. When the user does not operate with the instrument next 30 minutes, the instrument switches off.

8.3 Information line

After powering on the display shows measured data. Beyond descriptions of the measured values and their actual values the display shows an information line in its upper part.Please refer Figure

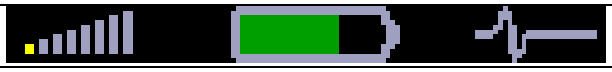


Figure 13 Information Line on display

Meaning of Displayed Symbols:

 - moving “wave” signifies measurement in progress,

 - setting of earphone output volume is indicated by yellow coloring of the bars,

 - this symbol shows an approximate battery status. If the battery symbol is filled more, then more battery power remains. If the status goes under 20 %, the remaining energy shows in red, if it is insufficient, the symbol is red and the instrument switches itself off.

Battery status symbol:


100%


approx. 50%


under 20%


just before switching off

8.4 Using of Headphone

The instrument is equipped by a 0.5 W amplifier for connecting of earphones and listening to a measured signal. We can connect the headphone by a stereo 3.5 mm jack marked phones on the top of the instrument. After connecting we can hear a signal from the vibration sensor in the earphones. Advisable volume can be set-up by the VOLUME item from the instrument menu (Please refer Figure 14 for details)

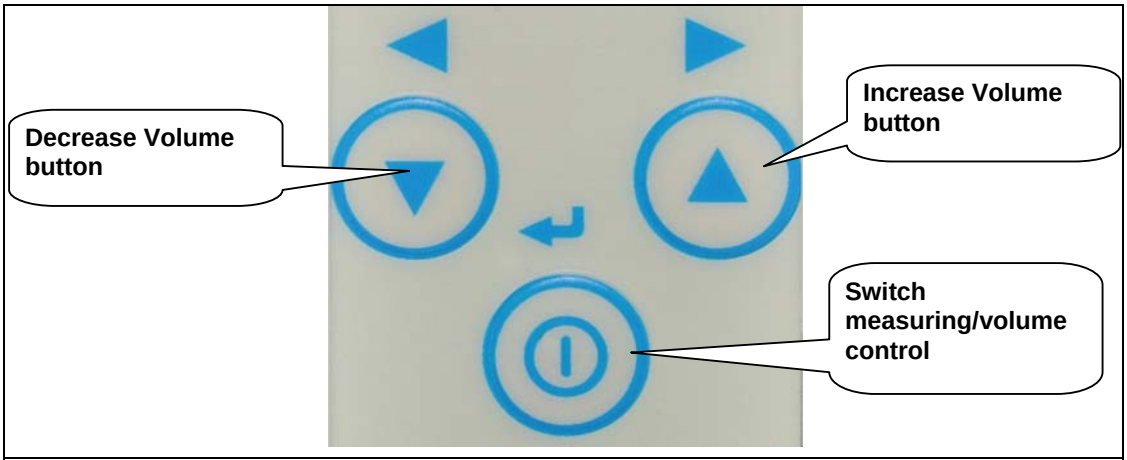


Figure 14 IRD449 Headphone Control

8.5 Selection of Measurement

A selection of measuring screen (method) can be performed by arrow buttons ▼ ▲. After press of a button an “empty screen” is shown without measured data, and the measuring starts. Please refer Figure 15 for the controls.

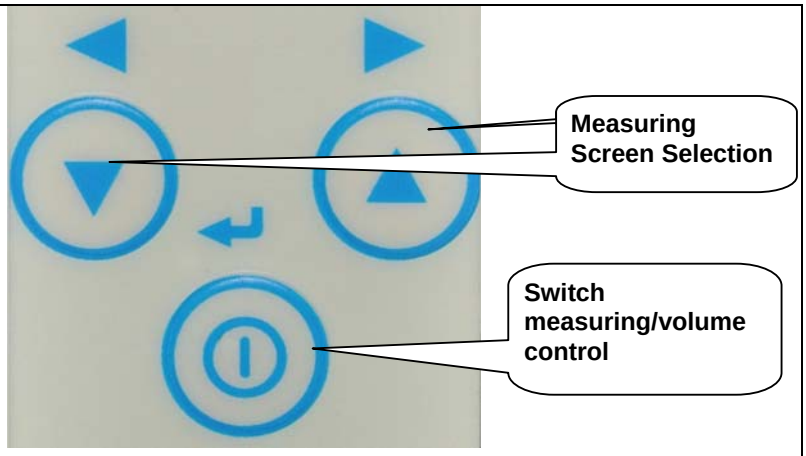


Figure 15 IRD449 Measuring Screen Selection Buttons

8.6 Measurement Methods Screens

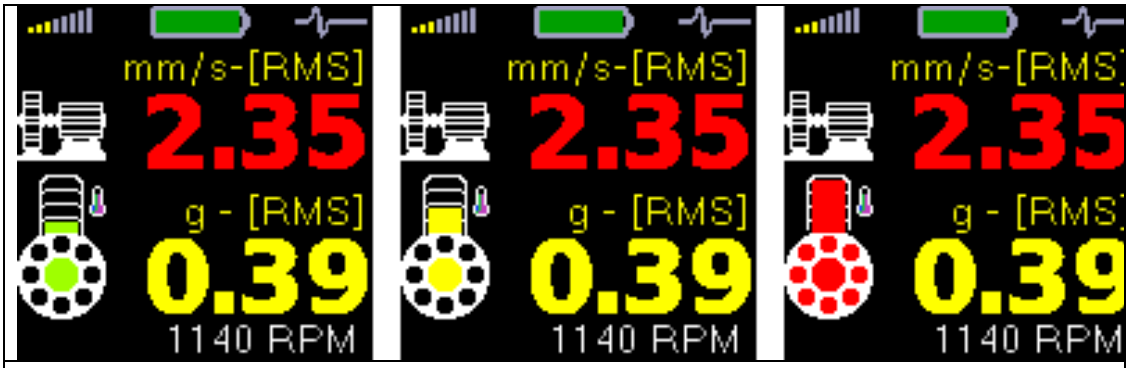


Figure 16 Measurement Methods Screen

Please refer Figure 16 for the measurement method screens.

Overall RMS values
Measurement of RMS vibration values in the ranges:
10 Hz - 1000 Hz in mm/s,
0.5 kHz - 16 kHz in g,
with estimated value of machine speed frequency.

Based on the speed and vibration values of the machine condition, colour of displayed value - green / amber / red - is determined. The colour of bearing is determined regarding to the measured temperature.

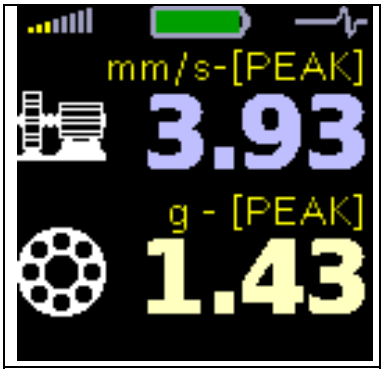


Fig 17A Overall Peak Values

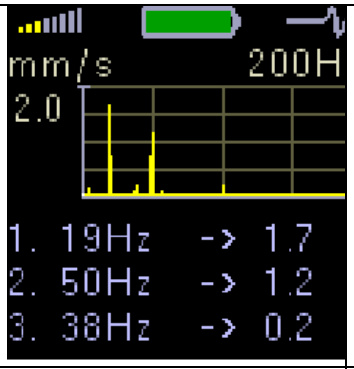


Fig 17B Spectrum 200Hz Looseness

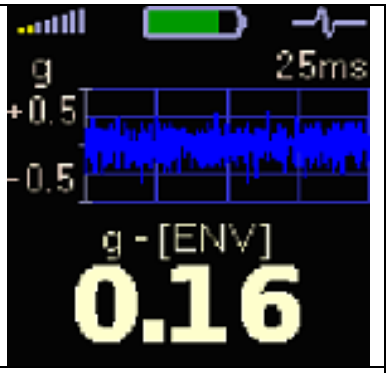


Fig 17C Time Signal for Roller Bearing

Please refer Figure 17A, 17B and 17C for the measurement screens.

Overall PEAK values
Measurement of peak vibration values in the ranges:10 Hz - 1000 Hz in mm/s,0.5 kHz - 16 kHz in g

Spectrum 200 Hz–looseness detection
FFT analysis of vibrations in the range: 2 Hz - 200 Hz in mm/s RMS, with display of 3 maximum peaks found .The peaks are ranked according to amplitude vibration size.

Time signal for roller bearing diagnosis
Measuring of time signal and vibrations in the range: 0.5 kHz - 16 kHz in g.
Displays actual measured time signal and g_{ENV} value.

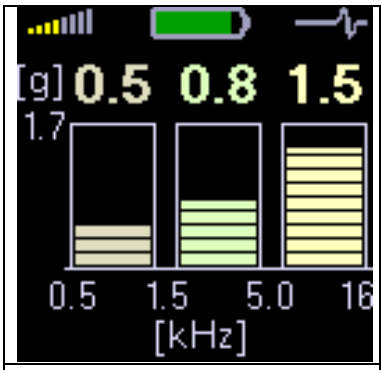


Fig 18A Vibration in Frequency Range Gearbox/Bearing

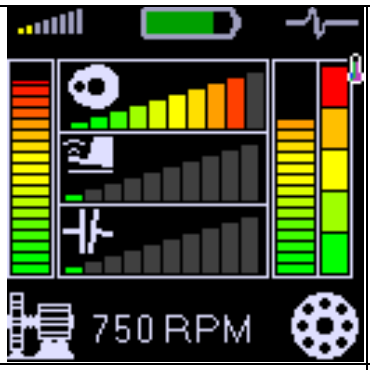


Fig 18B FASIT Screen

Fig 18C FASIT Screen – No RPM

Please refer Figure 18A, 18B and 18C for the measurement screens.

Vibrations in frequency ranges – gearbox/bearing
Measurement of RMS vibration values in the ranges:
0.5 kHz - 16 kHz in g,
1.5 kHz - 16 kHz in g,
5 kHz - 16 kHz in g.

FASIT Expert System
The FASIT screen. It displays the severity levels of machine faults. Also the temperature bar is displayed on the right side.

When the RPM is not found then no results are displayed (from ver.2.05).

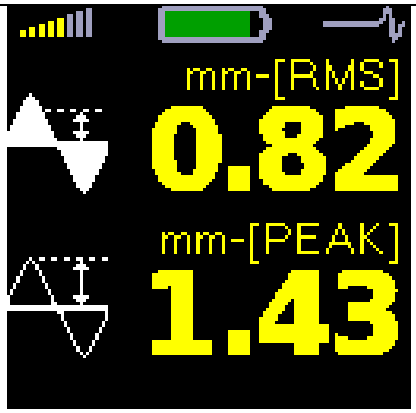


Fig 19A Overall RMS Displacement

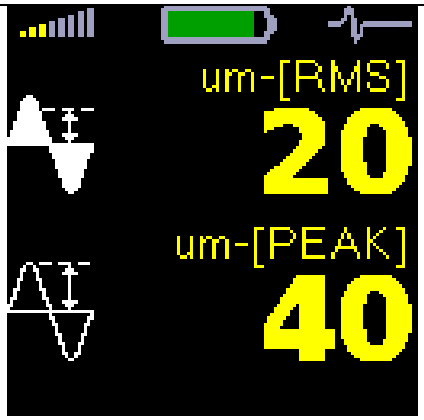


Fig 19B Overall Peak Displacement

Overall RMS and Peak displacement values in the range 2-200 Hz in mm. From ver.2.05, the displacement is displayed in microns. This is depicted in Figure 19A and 19B.

8.7 Speed detection and definition

After switch on of the instrument the Screen depicted in Figure 20A appears and the automatic speed detection begins. The detection procedure is displayed as running bar in the bottom of screen. The result is also displayed on the bottom.

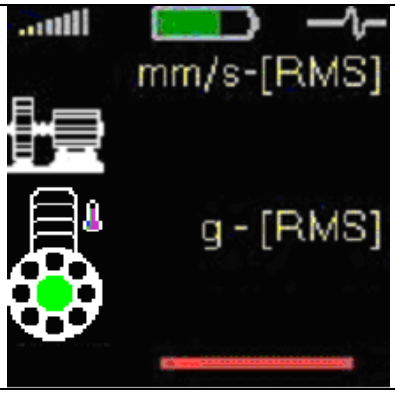


Fig 20A Start-up screen for automatic speed detection

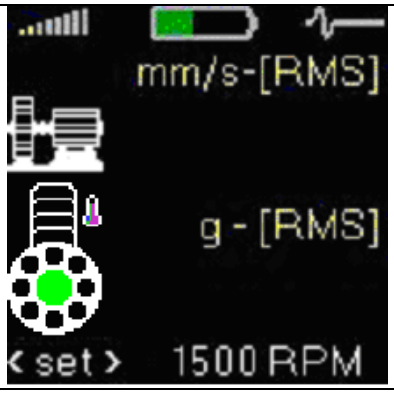


Fig 20B Automatic Speed Detection- Last Speed Value

When the automatic speed detection is not successful (see Automatic detection of the machine rotation chapter), the last speed value is loaded from the memory and displayed together with the message **(Figure 20B)**

Push arrows, it changes the value of speed with the step 250 RPM. When the correct speed (or the value near the correct speed) is defined, push Enter button for confirmation.

If no pushbutton is used for approx. 4 seconds, then the displayed value is accepted. The word **<set>** is changed to! MAN**!**, then this word informs all the time the user, that speed is entered manually.

When you need to set exact value and the 250 RPM step is too much, then use the STROBO item from the MENU.

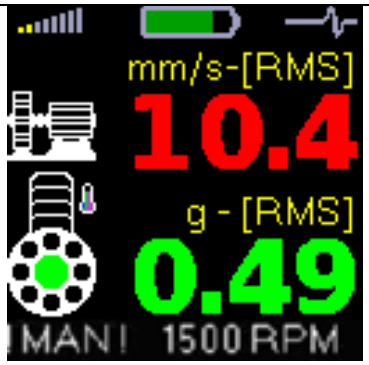


Figure 21A RPM set manually

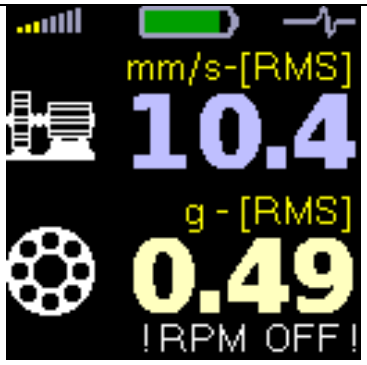


Figure 21B RPM detection switched OFF

If the automatic detection is switch on, this procedure of speed detection runs always when the Screen No.1 appears. !RPM OFF! is displayed when the RPM detection is switched off. Please refer Figure 21A and Figure 21B

8.8 Menu for functions selection

By pressing ⓘ button, the instrument menu appears. If the instrument is in the error stage (for example “SENSOR ERROR“), then some functions are not available.

LIGHT - Torch mode
STROBO - Stroboscope mode
VOLUME - Phone output volume adjustment
SETUP - This item opens next item selection:
SPEED - Set of speed detection
ALARMS - Selection of standard, which will define limit values
UNIT - Unit options for a measuring of a velocity signal (mm/s vs. ips)
ESC - - Return to the measuring screen

If the error is detected (e.g. “SENSOR ERROR"), then some item are not available. Move between items by pressing ▼ ▲ buttons. Select item by pressing ⓘ button. Use ***- ESC*** for return from Menu. Please refer Figure 22 A, B & C for details.

Figure 22A IRD449 Instrument Menu

Figure 22B IRD449 Instrument Menu (in error stage)

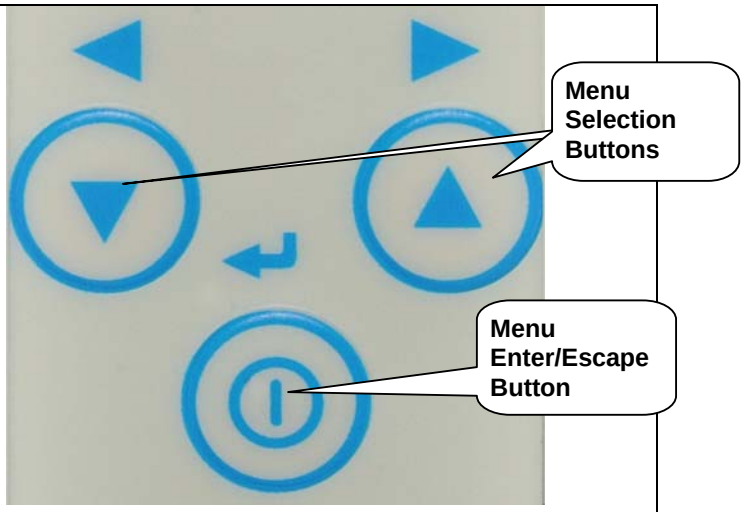


Figure 22C IRD449 Measuring Screen Selection Buttons

8.8.1 LIGHT

In LIGHT mode it's possible to use instrument like a torch. Select the LIGHT mode and press ⓘ button. White LEDs on the front side begins to light. Symbol of a torch appears on display as shown in Figure 23. Press any button to switch off the light and the instrument starts to measure again.

Figure 23 Torch Mode

8.8.2 STROBO

In STROBO mode you can use the instrument as a stroboscope. White LEDs on the front side begins to flash with a frequency, which is set up on the screen. If the speed detection is known, then frequency of flashes is set to that value. By pressing ▼ ▲ buttons you can also change that frequency manually. The step (1, 10,100 RPM) is displayed on the bottom line of the screen. Press the ⓘ button and the STROBO menu appears. You can switch-off (STOP) the stroboscope or change the step frequency tuning. Please refer Figure 24A and 24B for details.

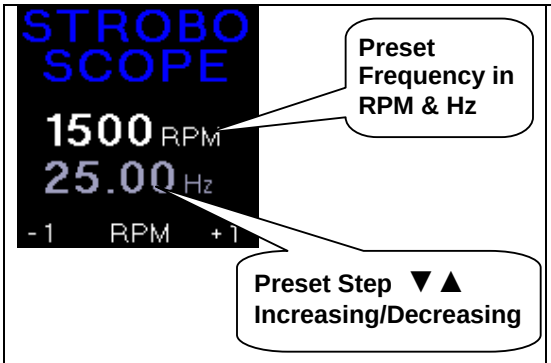


Fig 24A RPM set manually

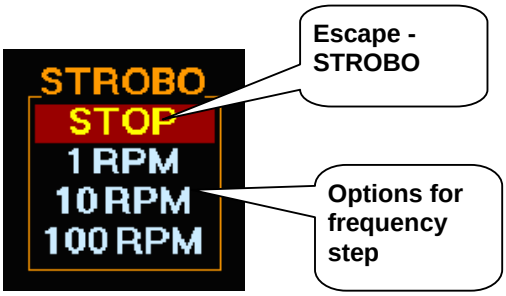


Fig 24B Strobo Mode Menu

8.8.3 VOLUME

The volume bars appear. The volume is changed by buttons ▼ ▲. When the maximum volume is reached, the symbol will become orange otherwise the amount of yellow filling shows the actual volume. If the earphones are off, the symbol is grey. Next press of the button ⓘ returns the instrument back to the measurement mode. Please refer Figure 25 A and Figure 25B for details.

Figure 25 A Volume Adjustment


Swicthed Off


CCA 50%


Maximum

Figure 25 B Displayed Volume

During the instrument is switched on or off, the range is changed, the sensor is connected or disconnected, the short unpleasant crack can be heard. This is not a defect of the instrument.

ATTENTION

Be careful not to overload the headphone amplifier by excessive volume. This will distort a signal in the headphone.

You can use any ***stereo*** or ***mono*** headphones with nominal impedance higher than ***8 Ω.*** Both output stereo channels are connected to the signal.

8.8.4 SETUP

Further functions menu appeared. Choose requested function using arrows and confirm by ⓘ Enter.

8.8.5 SPEED

Fig 26A Speed Menu Setting

Fig 26B Speed Menu AUTO

Please refer to Figure 26A and 26B for menu screens. Switch on (AUTO ON) or switch off (AUTO OFF) automatic detection of RPM. The manual enter is required, when AUTO OFF. For ver.2.05 and higher more options are available:

AUTO - automatic speed detection
MANUAL - always manual entry of speed
OFF - speed value is ignored, no limits with relation to speed are used.

8.8.6 ALARMS

Standards setup, Alert limits (amber colour) and Danger (red colour) will be defined. Please refer to Standards for vibration measurements.

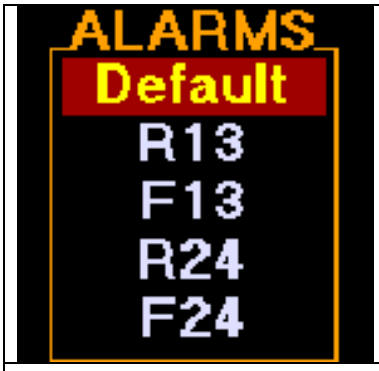


Fig 27A Alarm Setting

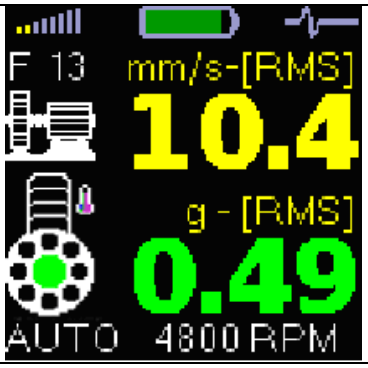
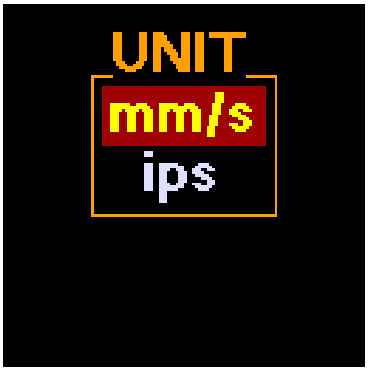


Fig 27B Alarm Setting with Machine Symbol

Chosen standard is displayed in the Figure 27B above, the machine symbol (F13 in this case). If IRD Mechanalysis standard is chosen, nothing is displayed.

8.8.7 UNITS

Vibration speed unit can be chosen here. mm/s (millimetres per second) and ips (inch per second) are available. Device remembers chosen unit even after switch off.

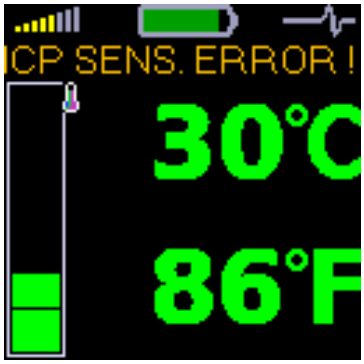


8.8.8 ESC-

Return to the MENU screen.

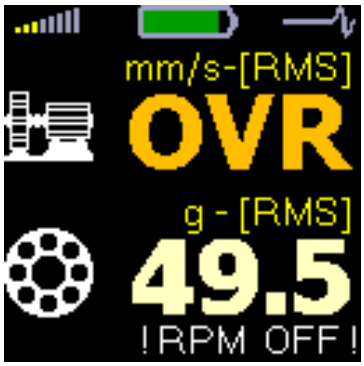
8.9 Error Messages

8.9.1 Sensor connection Error



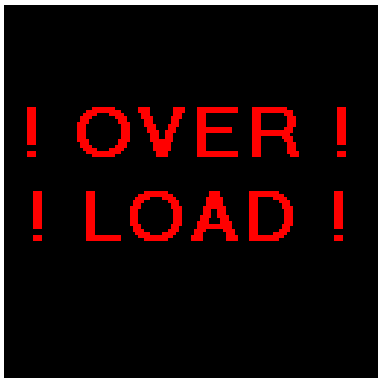
When incorrect connection of a sensor, unsuitable sensor type, broken cable etc. is detected, then the temperature screen occurs and the error message is written upon the values.

8.9.2 Display Value Overload



When the value exceeds the range of display, then OVR is displayed.

8.9.3 Input Overload Error



If an input signal is too strong (higher than 12V peak), the instrument cannot process it, the overload error is displayed. The instrument is not capable of measuring this signal.

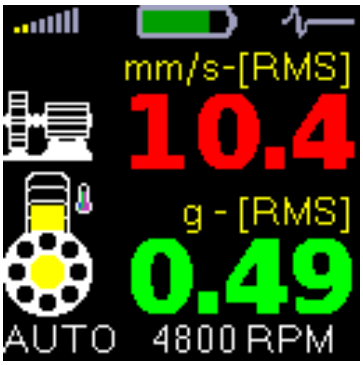
8.9.4 Measurement Error

If there is a break in communication between measuring and display boards inside of the instrument, this measurement initialization error is displayed (MEAS INIT). If you see this error, it means that the instrument is malfunctioning and we recommend to send it to the manufacturer for repair.

9. HOW TO EVALUATE THE FAILURE

The instrument shows measurement results on several separate screens. We shall describe basic rules for their use.

9.1 Overall RMS values



 - Machine symbol - this line shows RMS velocity vibration value in mm/s or ips, which is excited on the machine by mechanical phenomena related to:
- imbalance of rotational parts of the machine (fan wheel, impeller, clutch wheel etc.),
- incorrect axis alignment of the assembly – misalignment,
- mechanical looseness of individual machine parts,
- large free play in seating of rotational machine parts (shaft - bearing, shaft – bearing housing),
- clutch free play (e.g. free play on a shaft, pressed out grooves and tongues),
- loose or worn out machine anchor bolts,
- defective base,
- insufficient frame or anchoring flange rigidity,
- damage to machine rotation parts - (bent shaft).

 - Bearing symbol – this line shows RMS acceleration vibration value in g, which is excited by a condition of bearing. This condition is related to:
- time wear of the bearing,
- bad lubrication (with new bearings as well),
- incorrect installation (with new bearings as well),
- abrading of bearing.

The thermometer symbol is drawn together with the bearing. The temperature color is used according the actual measured value.

SPEED - The machine speed is displayed at the bottom part of the screen (if it is available). RPM means revolutions per minute. The instrument performs automatic detection of machine revolutions using a spectrum analysis. This function does not have to be always successful, because the revolutions may not be possible to read for every spectrum. If the speed is not determined, it is not a malfunction. It is hard to do it, for example, in machines with gears.

If the speed is available, then  and  vibration values have been coloured corresponding to vibration limits. Machine conditions are divided into 3 levels, which have the same colours like traffic lights:

1.GOOD – GREEN COLOUR

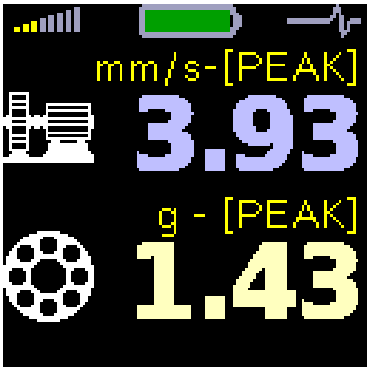
Machine is in good condition, no defect is found. The operation is without restrictions.

2.ALERT - AMBER COLOUR

The beginning defect has been found on the machine. It is possible to operate with paying more attention and planning of repair.

3. DANGER – RED COLOUR
There is an serious defect found on the machine. Machine shouldn't be in operation

9.2 Overall PEAK values

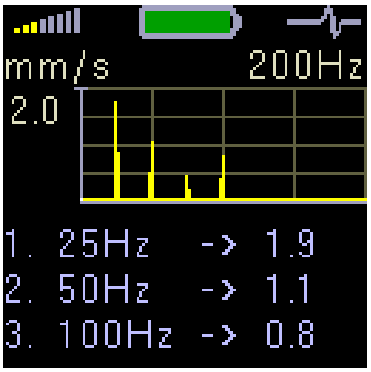


Similar rules for evaluation of the measured values, as in the previous screen are valid for this screen with one difference. The peak (PEAK) vibration values are displayed. It is highest measured value in certain time, which is important for transient shock events evaluation, especially in cases of incipient bearing defects, like:

- microscopic peeling off of a hardened surface layer in the place of a rolling element contact with a bearing ring (regular shocks),
- contamination of bearing space by metal particles (irregular shocks),
- cracks.

Shocks which cause these defects are also parts of the RMS vibration values. However, the peak value of such shock is hidden in a value which contains all other information about vibrations, i.e. noise from possible abrading, wrong lubrication and overloading. To simplify, the RMS is an average value of all vibration values achieved in certain time. If a large peak value (one shock) appears in this time period, it will be lost in the final recalculation of all the values.
This practically means that during increasing of this bearing defect that causes the shock, the PEAK value of this shock will visibly increase, while the effective (RMS) value will increase only slowly. We can discover the initial defect time of the bearing sooner. But PEAK value is not so stable as RMS value. For bearing condition measurement is the RMS measurement sufficient.

9.3 Spectrum 200 Hz– Detection of Looseness



This screen is important for detection of the mechanical looseness. When the graph shows a number of lines (typically 3 or 4) with the same space between them and the first line is on the speed frequency (see the value description on the bottom) probably mechanical looseness is the machine problem.
The most common causes of this defect are:

- soft flanges,

- loose anchoring bolts,
- cracks in frames – cracked welds,
- free play in rotational part seating,
- or possibly other problems not related to mechanical looseness,
- bent shaft.

See also FASIT chapters.

9.4 Time signal for bearing condition evaluation

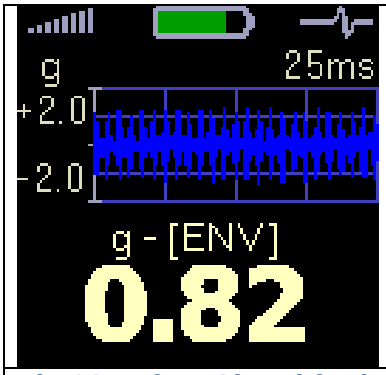


Fig 28A Time Signal for bearing vibrations

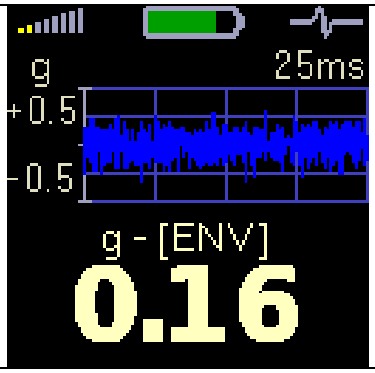


Fig 28B Undamaged Bearing

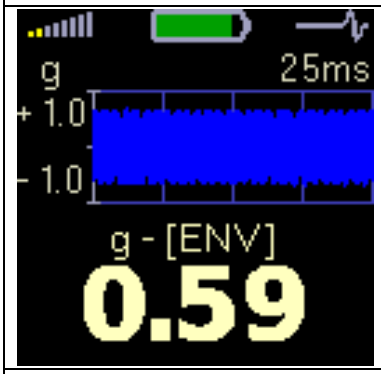


Fig 28C Undamaged Bearing – wrong lubrication

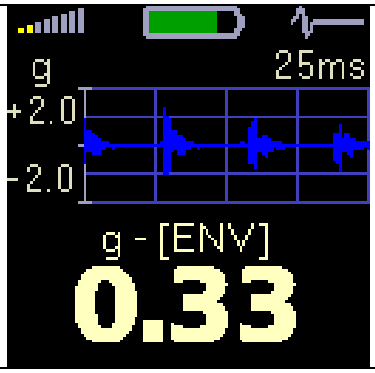


Fig 28D Damaged Bearing

The time signal of bearing vibrations is displayed. **g_{ENV} value** is under the time signal (envelope modulated signal. Please refer Figure 28A

The time signal is displayed as a direct record, not after envelope modulation. Look at three basic screens for easy work with this function.

Undamaged bearing: (Refer Figure 28B)

This bearing generates a low amplitude noise only, whose time record shape is steady.
It's necessary to have a look on the range of the graph (left side). Signal could look high but it's not when the graph range is low (for instance 0,5 g).

Undamaged bearing – wrong lubrication: (Refer Figure 28C)

The time record shape is steady too but it has bigger amplitude then previous case. You can clearly see different (bigger) range of the graph (1,0 g)

Damaged bearing: ((Refer Figure 28D)

There are clearly visible shocks caused by a rolling element coming across the damage like pitting or crack here. The shocks repeat themselves regularly. The range of the graph is different again (2,0 g in this case).

9.5 Vibrations in frequency bands – gearboxes/bearings.

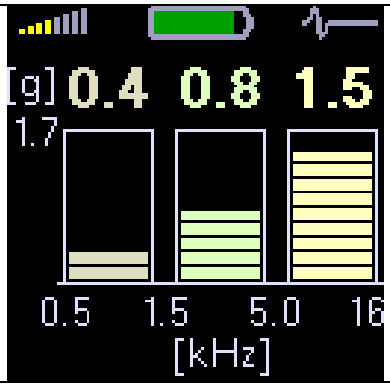


Figure 29 Gearbox Vibration- Acceleration in three frequency bands

When we need to find the failure on not simple machines (e.g. gearbox) then it is very useful to know the vibration values in several frequency bands.

Figure 29 shows measurement acceleration values in three frequency bands:
0.5 – 1,5 kHz, 1.5 – 5 kHz and 5 kHz – 16 kHz.

Example:
We are going to show the analysis procedure on a signal obtained on a seating of an inlet transmission shaft with the speed frequency 25 Hz (1500 rpm) and with a gear with 65 teeth. So called tooth frequency can be obtained by simple multiplication of the shaft revolution frequency (in Hz) by the number of teeth.

$f_{GMF} = f_{speed} * z$

f_{GMF} gear mesh frequency
f_{speed} speed frequency
z number of teeth

In our example the tooth frequency is 1625 Hz (so approx. 1,6 kHz).

What are the possibilities?
The transmission is OK and tooth frequency of 1,6 kHz slightly increases vibrations in the second frequency band.

Bearing failure - vibrations are concentrated in the last frequency range 5 – 16 kHz

9.6 Fault Source Identification and Diagnostics

Description of FASIT has been described in the beginning of this manual. For correct evaluation the speed must be defined. The instrument can do it automatically or by user manual entry.

The machine condition is divided into 3 levels, which have the same colours like traffic lights. The same approach we also use for fault detection. This screen is depicted fault diagnosis screen in Figure 30,

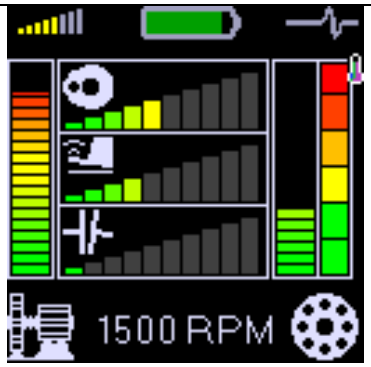


Figure 30 Machine Fault Diagnostics Screen

In the left bottom corner you see the Machine icon. The vertical bar displays the overall machine condition. This condition can be evocated by many reasons. The unit evaluates severity of 3 sources, which are the most occurred in the practice:

- Unbalance (circle with heavy spot icon),
- Looseness (shoe icon)
- Misalignment (clutch icon).

Correspondent faults horizontal bars are in middle.

On the right bottom corner you find the rolling bearing icon. The vertical bar displays the bearing condition. The meaning of Machine and Bearing bars was described earlier in this manual.

The temperature bar is displayed quite on right side. The ranges of colours are for less than 30°C - green, 30-45°C - yellow, 45-60°C - orange, 60-75°C - red and for greater than 75°C – dark red.

9.6.1 What do the colours means in fault bars of machine and bearing?

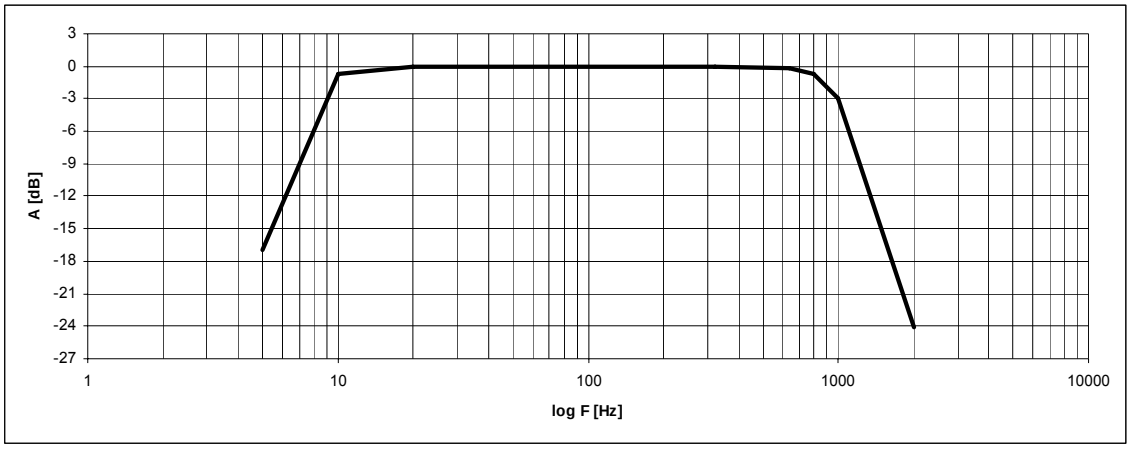
GREEN COLOR
It may surprise somebody, because why to think about faults when the colour is green. But also from low level signal the procedure can read the beginning of the fault. But the operation is without restrictions.

AMBER COLOR
The beginning level of defect is found on the machine. It is possible to operate with paying more attention and planning of repair.

RED COLOR
There is the serious defect level found on the machine. Machine shouldn't be in operation.

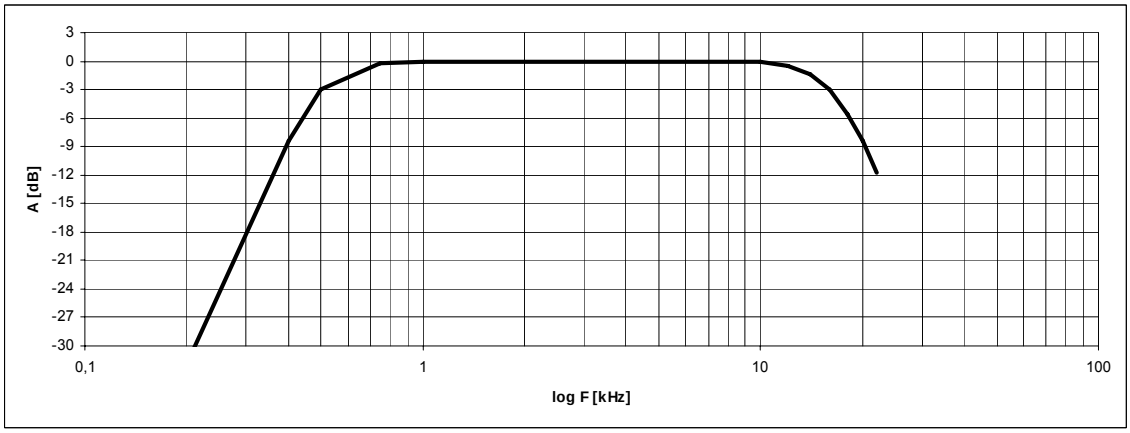
10. Response Specification

10.1 Vibration velocity measurement frequency response



Measurement accuracy (10 mm/s RMS input signal) is +/- 2.5 % (5-500 Hz frequency range) and +/- 5% (500 – 2000 Hz range).

10.2 Vibration acceleration measurement frequency response



Measurement accuracy (1 g RMS input signal) is +/- 2.5 % in 0,2 -20 kHz frequency range.

10.3 Velocity measurement amplitude response

Measurement accuracy for RMS vibration velocity (0.1 – 100 mm/s range) on 80 Hz reference frequency is +/- 2.5 %

10.4 Acceleration measurement amplitude response

Measurement accuracy for RMS vibration acceleration (0.1 – 10 g range) on 8kHz reference frequency is +/- 2.5 %

11. CALIBRATION

The calibration procedure described herein is supplied for the customer information only. No attempt to disassemble or calibrate the unit should be made except by an experienced, qualified technician using the proper test equipment. IRD Mechanalysis assumes no responsibility for the operation or units repaired or calibrated outside the factory or at an unauthorized service centre.

The following test equipment are required for calibration:

1. Standard 4 ½" Digit Digital Multi-meter
2. Standard Function Generator
3. Electrodynamic Shaker

NOTE:
Please ensure that the test instruments used for calibration are calibrated with references traceable to National / International Standards and have valid calibration status.

11.1 Calibration Procedure for IRD449 VDSM

11.1.1 Sensor Sensitivity

Before any calibration you need to know, what exact sensitivity of sensor is set in the instrument. See the initial screen, which contains this information.

Description of numbers in initial screen:
1. The sensor sensitivity mV/g times 10 (983 means 98,3mV/g)
2. Firmware version (V2.05 dtH)
3. HP filter frequency for bearing in kHz (0.5 kHz)

The sensor sensitivity is not equal 100mV/g very often. The sensitivity of sensor is usually in 95-105 mV/g range. Let suppose the sensitivity which is set in the instrument is equal **S**. Then all calibration measurements, which are adjusted to the sensitivity 100mV/g must be multiplied by **100/S**.

11.1.2 Basic test with Electrodynamic Shaker

If you have an elctrodynamic shaker, you can regularly test the unit on two frequencies 80Hz and 8kHz. On the initial IRD449 screen are displayed RMS values of velocity and acceleration. The velocity value should be 10 mm/s and the acceleration should be 0.5g.

The signal from the shaker with the reference sensor is adjusted for exact 100mV/g sensitivity. When the sensitivity of IRD449 unit is e.g. 95mV/g, then the higher values (10.5mm/s and 0.53g) will be displayed. Expected values from the A4801 should be multiplied by 100/95 coefficient.

11.1.3 Basic test with sensor and shaker

Set on the shaker 10mm/s on 80Hz and check the RMS velocity value on the initial screen. Then set 0.5g on 8kHz and check the RMS acceleration. If you have trouble to generate the 8 kHz, you can use lower frequency, but not lower then 1200Hz. Bellow this limit the LP filtering is applied and the result would be distorted.

11.1.4 Advanced tests of velocity measurement

Use the shaker and sensor. You can make the frequency response and the amplitude response.

Use the amplitude 10mm/s for frequency response test. Change the frequency from 6 to 1200 Hz and check the filtration curve, which is drawn in previous chapter. Also the accuracy is mentioned there.
Set the 80Hz for amplitude response. Change the amplitude from 0.1 to 100 mm/s and check the accuracy (+/- 2.5%).

11.1.4 Advanced tests of acceleration measurement

Use the shaker and sensor if you are able to shake high frequencies (10 kHz or more). If your shaker system does not allowed it, use the signal generator and switch the ICP off.

Use the amplitude 1g for frequency response test. Change the frequency from 500 to 12000 Hz and check the filtration curve, which is drawn in previous chapter. The accuracy is +/-2.5%. Set the 8kHz for amplitude response. Change the amplitude from 0.1 to 10g and check the accuracy (+/- 2.5%).

11.1.5 Envelope demodulation test

The envelope value is RMS value. Do not use comparing with peak values. Use the 8kHz pure sine signal with 1g (100mV) amplitude. The ENV should display 1.33g +/- 2.5%.

11.2 Sensor Calibration

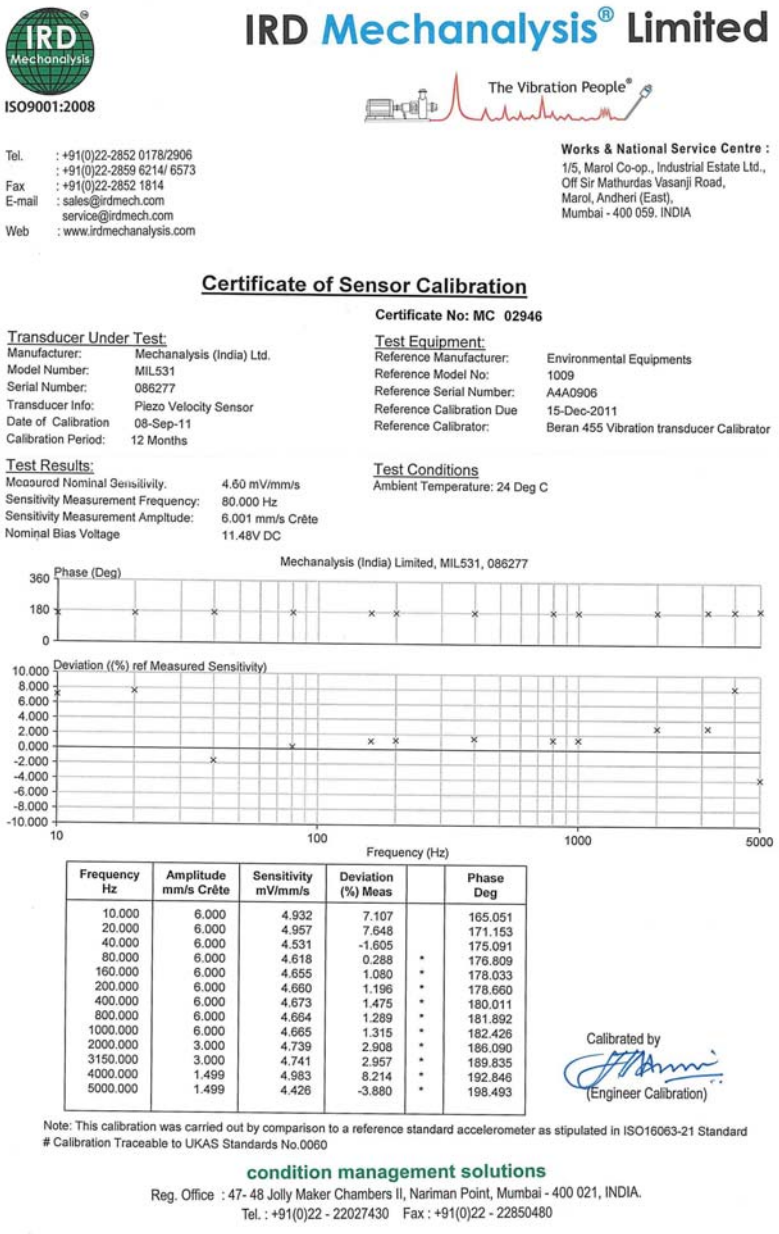
The calibration of the IRD511 Piezoelectric sensor supplied with the instrument or any other vibration sensor out of the wide range of IRD500 Sensor Series can be done at the state of the art Calibration Lab at IRD, Mumbai (Figure 31).

Figure 31 State of the art IRD Calibration Lab, Mumbai

This Lab has a state of the art TransCal system from Beran Instruments UK. It is an automatic digital sensor calibration system. It undertakes calibration of a sensor throughout

its frequency range. The master reference sensor is traceable to National Standards. Calibration Certificates are generated and stored for each sensor tested. IRD has constructed an environmentally controlled Lab environment for all sensor calibration tests. This service could be availed by all users irrespective of sensor manufacturer. For each calibrated sensor, a traceable calibration certificate is generated which is a full frequency calibration with phase response depicted on the certificate. The certificate also lists down the validity of the calibration, which is 12 months. Last but not the least; it states the national standard to which the calibration is traceable. A typical certificate is reproduced in Figure 32.

Further details could be obtained from our regional offices in the four metros, Works or National Service Centre, Mumbai. The addresses and contact details are given at the start of this manual.



IRD Mechanalysis® Limited

ISO9001:2008

The Vibration People®

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Fax : +91(0)22-2852 1814
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service@irdmech.com
Web : www.irdmechanalysis.com

Works & National Service Centre :
1/5, Marol Co-op., Industrial Estate Ltd.,
Off Sir Mathurdas Vasanji Road,
Marol, Andheri (East),
Mumbai - 400 059. INDIA

Certificate of Sensor Calibration

Certificate No: MC 02946

Transducer Under Test:
Manufacturer: Mechanalysis (India) Ltd.
Model Number: MIL531
Serial Number: 086277
Transducer Info: Piezo Velocity Sensor
Date of Calibration 08-Sep-11
Calibration Period: 12 Months

Test Equipment:
Reference Manufacturer: Environmental Equipments
Reference Model No: 1009
Reference Serial Number: A4A0906
Reference Calibration Due 15-Dec-2011
Reference Calibrator: Beran 455 Vibration transducer Calibrator

Test Results:
Measured Nominal Sensitivity. 4.60 mV/mm/s
Sensitivity Measurement Frequency: 80.000 Hz
Sensitivity Measurement Amplitude: 6.001 mm/s Crête
Nominal Bias Voltage 11.48V DC

Test Conditions
Ambient Temperature: 24 Deg C

Mechanalysis (India) Limited, MIL531, 086277

Phase (Deg)
360
180
0

Deviation ((%) ref Measured Sensitivity)
10.000
8.000
6.000
4.000
2.000
0.000
-2.000
-4.000
-6.000
-8.000
-10.000

10
100
1000
5000
Frequency (Hz)

Frequency Hz	Amplitude mm/s Crête	Sensitivity mV/mm/s	Deviation (%) Meas		Phase Deg
10.000	6.000	4.932	7.107		165.051
20.000	6.000	4.957	7.648		171.153
40.000	6.000	4.531	-1.605		175.091
80.000	6.000	4.618	0.288	*	176.809
160.000	6.000	4.655	1.080	*	178.033
200.000	6.000	4.660	1.196	*	178.660
400.000	6.000	4.673	1.475	*	180.011
800.000	6.000	4.664	1.289	*	181.892
1000.000	6.000	4.665	1.315	*	182.426
2000.000	3.000	4.739	2.908	*	186.090
3150.000	3.000	4.741	2.957	*	189.835
4000.000	1.499	4.983	8.214	*	192.846
5000.000	1.499	4.426	-3.880	*	198.493

Calibrated by
(Engineer Calibration)

Note: This calibration was carried out by comparison to a reference standard accelerometer as stipulated in ISO16063-21 Standard
Calibration Traceable to UKAS Standards No.0060

condition management solutions
Reg. Office : 47- 48 Jolly Maker Chambers II, Nariman Point, Mumbai - 400 021, INDIA.
Tel. : +91(0)22 - 22027430 Fax : +91(0)22 - 22850480

Figure 32 A typical National Traceable IRD Sensor Calibration Certificate

12. SPECIFICATIONS

12.1 IRD449 Vibration Diagnostic SmartMeter

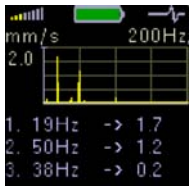
The IRD449 is a portable multi-function SmartMeter that bridges the gap between the overall level vibration meter and the advanced FFT data collector / analyser and associated analysis software. It is a complete machine condition diagnostic tool that produces results on-site without the need for a computer. It is designed for the technician, engineer and consultant who require portability, ease of use and speed to identify prime machinery faults without taking expensive delicate instruments to plant sites. It is the ideal replacement for the IRD838 basic analyser.

This single instrument undertakes overall Vibration Measurement, Three Band FFT Spectrum, Time Wave Form, Diagnostics, Temperature, a Tacho for speed and Stroboscope. In addition it incorporates a handy inspection torch.

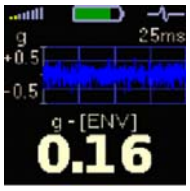
The IRD449 caters to ISO 10816-3 with expert rules covering machinery health vibration levels: that identifies prime machine faults: Unbalance, Looseness and Alignment. An anti-friction bearing health level indication is also incorporated. Below is a selection of the many informative screens available:

Set Up Menu

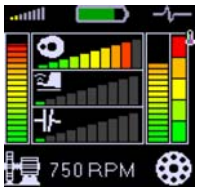
RMS Vibration & High Temp



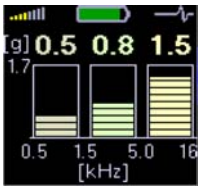
3 Spectrum Bands



Time Wave Form



Fault Diagnostics



3 Band Alarms

Do your machines work under optimum conditions? The IRD449 will:

- Determine the condition of your bearings, including slower-running rotors (120rpm)
- Identify insufficiently lubricated bearings
- Indicate unbalance, looseness, misalignment
- Check machine speed, unbalance and alignment etc by built-in stroboscope
- Measure in either Metric or English units

Operation of IRD449 is easily learned. The screen displays machine status in colours green, orange and red. Determination of individual machine or bearings defect types is undertaken directly during the measurement process without the need of a computer or software.

While the IRD449 is big in performance, it is compact, rugged and fits in the palm of the hand.

The model IRD449 takes a variety of measurements as selected:

- Overall RMS and PEAK velocity (10 - 1000 Hz)
- Overall RMS and PEAK acceleration (500 - 16 000 Hz)
- Overall RMS and PEAK displacement (2 - 100 Hz)
- Velocity Spectrum (200 Lines FFT)

The IRD449 is supplied complete with standard accessories: accelerometer, coiled cable, magnetic base, headphones and carry case. The headphones enable one to listen to machinery noise related to vibration and effects of the process. When measuring transmissions or slow-running bearings, the benefit of the headphone accessory is readily appreciated.

TECHNICAL SPECIFICATION

Measurements:

Input - 1 x ICP powered accelerometer

Input Range - 60g PEAK, with standard 100mV/g sensor
- (e.g. for 600g PEAK 10mV/g senor, sensitivity is programmable in the IRD449.

DETECTION	UNITS	FREQUENCY - RANGE	DISPLAY
RMS	mm/sec, ips	10-1,000 (opt. 1-1,000) Hz	0-999
PEAK	mm/sec, ips	10-1,000 (opt. 1-1,000) Hz	0-999
RMS	G	500-16,000Hz	0-999
RMS	G	1500-16,000Hz	0-999
RMS	G	5000-16,000Hz	0-999
RMS	um, mil	2-200Hz	0-999
PEAK	um, mil	2-200Hz	0-999
Time Wave Form	G	500-16,000Hz	0-999
FFT Spectrum	mm/s, ips	4-200Hz	0-999
Temperature	°C, °F	0-380 °C, (32-716 °F)	°C, °F

Display - Colour OLED, 128 x 128 pixels, diagonal 1.5" (38mm

Stroboscope - High intensity LED, 10 – 18000RPM (0.17-300Hz)

Torch - High intensity LED

Output - 1 AC signal 8 Ω /0.5W for external headphones (signal listening)

Power: - 2xAA 1.5V (alkaline, NiMH, LiFe), Battery condition indicated on meter display

Environmental - Operating temp -5°C to 50°C, Storage temp: - -20°C to 65°C

Packaging - Aluminium with dust and splash proof seal; quick access for change of batteries
Carrying case with internal protective foam

Weight & Dimensions

Instrument only: - 350g. (with batteries)

Instrument with Accessories: - 1 Kg. (complete with accessories in carrying case)

Dimensions (Instrument): -150mm (L) × 60mm (W) × 35mm (H)

BILL OF MATERIALS	Qty	Part Number
Model IRD449 Vibration Diagnostic SmartMeter		M449001
Sensor Accelerometer, model IRD511, 2-10KHz, 100mV/g, Top Exit, Mil 2 Pin, 1/4"-28UNF Female Mounting Thread with National Traceable Cal. Cert.	1	M5111005001000
Cable for model IRD449 Binder to accelerometer IRD511 expandable to 2.5m	1	M60164
Magnetic holder for IRD511 Accelerometer	1	M24746
Prod (Stinger) Al Straight for Sensor	1	M11030
Headphones with Ear Defenders	1	M91208
Carrying Case	1	M25352
Manual - Operating instructions in English and CD	1	M44999

IRD Mechanalysis® Ltd continues to be an industry leading provider of Condition Management Solutions. With a heritage of over 60 years experience in machinery vibration and associated technologies, IRD designs, manufactures and supports proven instrumentation suitable for harsh industrial environments.

The Vibration People of IRD Mechanalysis can be contacted at the following branches or your local distributor:

Mumbai	Delhi	Kolkata	Chennai	International
1/5, Marol Co-op. Industrial Estate Ltd, Off. Mathuradas Vasanji Rd. Marol, Andheri (East), Mumbai 400 059	Sagar Deep, Plot No.11 LSC Saini Enclave, Vikas Marg New Delhi 110 092	153/A, 2nd Floor VIP Road Kolkata 700 054	7-C, Chesney Nilgiri Apts 65, Commander-In-Chief Rd Chennai 600 105	1/5, Marol Co-op. Industrial Est. Ltd, Off. Mathuradas Vasanji Rd. Marol, Andheri (E) Mumbai 400 059, INDIA
Tel: +91(0)22-2852-0178 Fax: +91(0)22-2852-1814 sales@irdmech.com Service@irdmech.com	Tel: + 91(0)11-2237-3916 Fax: +91(0)11-2237-0778 salesNR@irdmech.com	Tel: +91(0)33-2355-2062 Fax: +91(0)33-2355-9214 salesER@irdmech.com	Tel: +91(0)44-2823-0726 Fax: +91(0)44-2823-4702 salesSR@irdmech.com	Tel: +91-22-2852-0178 Fax: +91-22-2852-1814 sales@irdmech.com

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CE

12.2 IRD511 Accelerometer Specifications

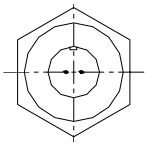
The IRD Mechanalysis model IRD511 is a standard accelerometer for measuring vibration on industrial rotating machinery. It has a top exit Mil 2 Pin Connector. This sensor is primarily used with portable vibration meters. A magnetic round base is available as optional accessory for portable vibration measurements.

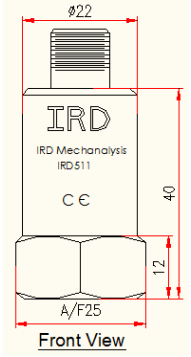
Applications: Applies to most Process Plants using Compressors, Blowers, Conveyors, Cooling Tower Fans, ID, FD, PA Fans, CW Pumps, Gear Boxes, Motors, Paper Machinery, Turbines etc.

Supplied Accessories	Qty	Part Number	Optional Accessories	Qty	Part No.
Sensor Mounting Adaptor Stud, M6	1	M60154	Cable 15 m Length with Mil 2-Pin connector		M60048
Calibration Certificate	1	CCIRD511	Magnetic Portable Base, IRD500 Series Accels	1	M24828

Dimensions & Connections

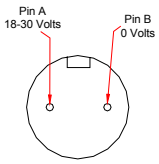
Plan View

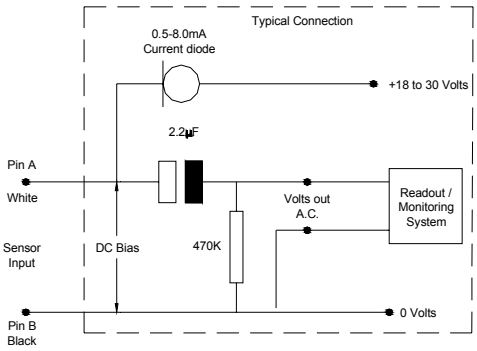




Front View

Side View





Technical Performance

Mounted Base Resonance	22 kHz (nominal)
Sensitivity	100 mVg ± 10% Nominal 80 Hz at 22°C
Frequency Response	2 Hz to 10 kHz ± 5% 0.8 Hz to 15 kHz ± 3 dB
Isolation	Base isolated
Measurement Range	± 80g
Transverse Sensitivity	Less than 5%

Electrical

Electrical Noise	0.1 mg max
Current Range	0.5 mA to 8 mA
Bias Voltage	10 – 12 Volts DC
Settling Time	2 seconds
Output Impedance	200 Ohms max
Case Isolation	$>10^8$ Ohms at 500 Volts

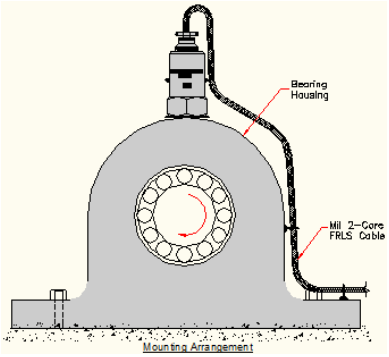
Environmental

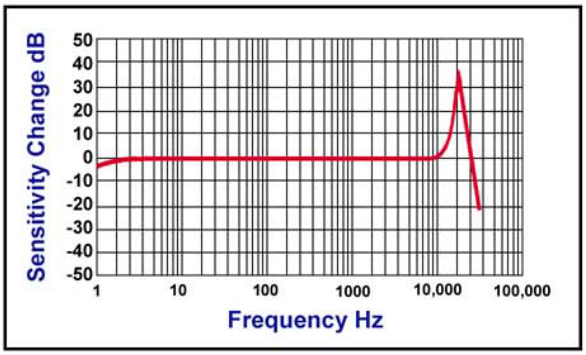
Operating Temperature Range	-55 to 140°C
Sealing	IP67
Maximum Shock	5000 g
Emissions	EN61000-6-4:2001
Immunity	EN61000-6-2:1999

Mechanical

Case Material	Stainless Steel
Sensing Element /Construction	PZT / Compression
Mounting Torque	8 Nm
Weight	110 gms (nom)
Maximum Cable length	1000 meters
Connector	2-pin Mil-C-5015
Mounting	¼" – 28 UNF Female
Options	Filters, Other sensitivities, Various connector assemblies Other Mountings

Mounting & Frequency Response





Part Number Selector

M = IRD Mechanalysis Product Prefix

Product Series IRD511
Accelerometer Standard, Top Exit

Cable/Conn Type
08 – Fire Retardant connector
50 – Mil 2 Pin Connector
54 – M12 Connector

Integrated Cable Length
000 – not applicable

M	5	1	1	1	0	0	5	0	0	1	0	0	0

Sensor Output
010 – 10 mV/g
030- 30 mV/g
050 – 50 mV/g
100 – 100 mV/g
250 – 250 mV/g
500 – 500 mV/g

Mounting Threads
01 – ¼"-28 UNF Female
02 – ¼"-28 UNF Male
05 – Quick Fit Female
06 – M6X1mm Male
08 – M8X1.25mm Male
10 – M10X1.5mm Male
12 – M12X1.75mm Male

Note on Sensor Output

- Most machinery applications are suitably covered by a sensor with a sensitivity of 100mV/g. However, you may wish specify different sensitivities because of the unique dynamic range of the particular machine to be monitored.
- A high sensitivity sensor, 500mV/g or 1V/g would be used for those machines operating at low speeds (say below 600 rpm) with high mass structures where vibration levels signals will inherently be of a low amplitude .
- For high dynamic ranges such as a high speed gearbox, you would use a lower sensitivity e.g. as low as 10mV/g, 50mVg etc.
- To ensure sensors are matched to specialised applications we recommend a detailed vibration analysis is undertaken first
- IRD Mechanalysis Consultancy Services can assist you in the best sensor solution.

The Vibration People of IRD Mechanalysis can be contacted at the following branches or your local distributor:

Mumbai	Delhi	Kolkata	Chennai	International
1/5, Marol Co-op. Industrial Estate Ltd, Off. Mathuradas Vasanji Rd. Marol, Andheri (East), Mumbai 400 059	Sagar Deep, Plot No.11 LSC Saini Enclave, Vikas Marg New Delhi 110 092	153/A, 2nd Floor VIP Road Kolkata 700 054	7-C, Chesney Nilgiri Apts 65, Commander-In-Chief Rd Chennai 600 105	1/5, Marol Co-op. Industrial Estate Ltd, Off. Mathuradas Vasanji Rd. Marol, Andheri (East), Mumbai 400 059 India
Tel: +91(0)22-2852-0178 Fax: +91(0)22-2852-1814 sales@irdmech.com Service@irdmech.com	Tel: + 91(0)11-2237-3916 Fax: +91(0)11-2237-0778 salesNR@irdmech.com	Tel: +91(0)33-2355-2062 Fax: +91(0)33-2355-9214 salesER@irdmech.com	Tel: +91(0)44-2823-0726 Fax: +91(0)44-2823-4702 salesSR@irdmech.com	Tel: +91-22-2852-0178 Fax: +91-22-2852-1814 sales@irdmech.com Service@irdmech.com

Keeping you going

13. Support Services

National Service Centre, Mumbai

Keeping you going is a IRD Mechanalysis® commitment. Product support is an essential aspect of any progressive business. IRD Mechanalysis® Limited (IRD) is no exception; the company has been supporting former IRD, then Entek well as IRD's products for the past 25 years. Indeed the acceptance and usage of these products by Indian industry is directly attributed to the dedicated support IRD has provided. IRD continues to invest in Customer Support. Just 'keeping you going' is not enough; we have facilities to ensure systems match world standards. Our instruments and systems are calibrated to National Standards.

The very nature of industrial electronic instruments, both portable and permanent, demands regular calibration. From time to time it becomes necessary to repair of damaged items such as cables, sensors, power supplies and occasionally electronic circuitry etc. IRD Mechanalysis® is well equipped for such eventualities

When equipment is in need of repair, a reliable repair centre that is responsive, convenient, and cost effective is required. IRD Mechanalysis® Ltd offers in-house as well as site calibration (traceable to National Standards) and repair services. This also covers our partner's product range; IRD also supports many obsolete products where components are still available or have been indigenised.

As the original equipment manufacturer (OEM), we are the most knowledgeable and the qualified to service our products. Supported by more than 50 combined years of technical service experience, our repair technicians provide the highest quality service for your IRD products. At our **National Service Centre** in Mumbai we stock a comprehensive supply of spare parts to ensure a quick turnaround.

13.1 BENEFITS and FEATURES

For IRD Mechanalysis® Ltd's customers, the **National Service Centre** offers the following:

- Fast in-house turnaround options
- Expert factory technical assistance
- Industry competitive repair charges
- In-house calibration of vibration sensors (traceable to National Standards)
- Regular cleaning and calibration to extend product life and reliability
- Instrument hire during repair period to minimize programme interruption
- 1 Year warranty on Product Exchange Programme
- Fixed Price Repair – Whole Product 3 months warranty
- 90-day parts warranty on all repair and calibration services

13.2 PRODUCTS SUPPORTED

The **National Service Centre** has the capability to support the following products:

- Data Collectors: IRD817, IRD818, IRD890, IRD Fast Track®, dataPAC®1000, dP1250, dP1500; Enpac® series. Also Commtest VB series of vibration analysers and profiler
- Portable Instruments: IRD306, MIL306, MIL306C, MIL306D, MIL306DD, IRD308, IRD350, IRD355, IRD360, IRD810, IRD811, MIL811, MIL811D, IRD820, IRD838, IRD870, IRD880, IRD885
- Protection Monitors: 5802, 5806, 5815, 5915, 5800 Cards, 6100, 6600 Series, MIL8700 Series, MIL8800 Monitor
- Machinery Diagnostic Systems: Beran 766, 767, 768
- Machinery Protection Transmitters: IRD7100 Series, IRD7200 Series, IRD7300 Series
- Balancing Systems: 245, 246, MILB50 and MILB150

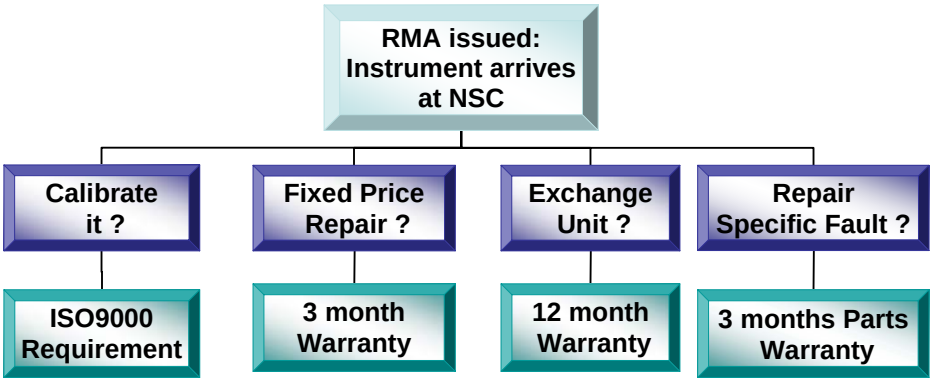
™ dataPAC, Enpac, and Fast Track are trademarks or registered trademarks of IRD Mechanalysis

Turnaround time and repair capabilities are dependent upon condition of equipment and spare parts availability at the time of the product assessment.

13.3 How the National Service Centre Optimises Clients Investments

- Annual Maintenance and Calibration ensures years of trouble free operation to maximize the investment in your condition monitoring equipment.
- A complete in-house supply of spare parts assures quick turnaround for product repairs.
- State of the art Sensor Calibration automatically over the full frequency range traceable and up to date to National Standards of the UK.
- IRD Mechanalysis® Ltd's ISO 9001 certification guarantees quality repairs and service.
- Our highly qualified Repair Centre technicians, supported by more than 50 combined years of technical service experience, give you the best available service and results.
- As the only authorized service centre for IRD Mechanalysis Ltd Products, our **National Service Centre** provide the most knowledgeable, experienced and committed support for all of our products.
- We offer a IRD Product Exchange Programme, Fixed Price Repair or Standard Repair and Calibration Only Services: the applicable warranty benefits are given below:

Service Options & Process



13.4 HOW TO GET SERVICE?

1. Before dispatching any instrument, cable, sensor etc it must be given an RMA number issued by the **NSC,** see below
2. For a Return Material Authorization number (RMA) this can be downloaded from our web site: www.irdmechanalysis.com
3. To discuss any instrument servicing issues please call Tel: +91(0)22-2852-0178 or one of our Regional Offices
4. Alternatively Email us at : service@irdmech.com
5. Complete the RMA and fax back to IRD Mechanalysis® at Fax: +91(0)22-2832-1814
6. When the RMA has been issued, the Client sends the instrument with all accessories together with the Purchase Order making reference to the RMA Number.
7. Upon receipt, IRD will evaluate the instrument and make a recommendation to the Client (if no instructions on type of service have been received earlier).
8. Only when the repair has been completed and payment has been received, will the instrument be returned to the Client.
9. Warranties will apply depending on the Repair Category option

LOCATIONS

National Service Centre
1/5, Marol Co-op. Industrial Estate Ltd,
Off. Mathuradas Vasanji Rd,
Marol
Andheri (East)
Mumbai
400 059
INDIA
Tel: +91(0)22-2852-0178
Tel: +91(0)22-2859-6214 / 6573
Fax: +91(0)22-2832-1814
Email: service@irdmech.com
Email: sales@irdmech.com

Head Office (Registered)
47 – 48 Jolly Maker Chambers II
Nariman Point
Mumbai
400 021
INDIA
Tel: + 91(0)22-2202-7430
Fax: +91(0)22-2285-0480
Email: ceo@irdmech.com
www.irdmechanalysis.com

RMA (Return Materials Advisory) Form

ATTN: IRD Mechanalysis Ltd, National Service Centre, 1/5 Marol Co-op, Industrial Estate Ltd, Off Mathurdas Vasanji Road, Marol, Andheri (E), Mumbai 400 059, India. +91(0)22-2852 0178 / 2906

FAX BACK RMA FORM: +91(0)22-2852 1814 or Email to : service@irdmech.com

Product Model:	Serial No:
Fault details (if applicable): Please tick appropriate box	

Warranty		Calibration		Fixed Price Repair		Exchange Units		Standard Repair	

This is to advise that we are planning to dispatch the above instrument for Calibration / Repair,
as detailed above, on (date):_____

Customer's Purchase Order No:		**Date:**	
P.O. Value: Rs. (if agreed)			
AMC Contract No (if applicable)**:**			

A purchase order must be provided before inspection will commence unless an AMC Contract is in place.

When NSC receives the Return Material Authorisation it will issue an RMA number. Only then send in the instrument with its RMA Nos tagged on the instrument for tracking purposes. A PO must accompany the instrument referencing the RMA Nos.

Please complete the details below to enable us to process your requirements as quickly as possible.

MUST BE COMPLETED IN ALL CASES			
Invoice Address		**Delivery Address**	
Company:		Company:	
Department		Department	
Address:		Address:	
City		City	
State		State	
PIN		PIN	
Contact Name:		**Contact Name:**	
Telephone:		Telephone:	
Mobile:		Mobile:	
Fax:		Fax:	
Email		Email	
		Users Name:	
		Designation	
		Signature	
		Date	

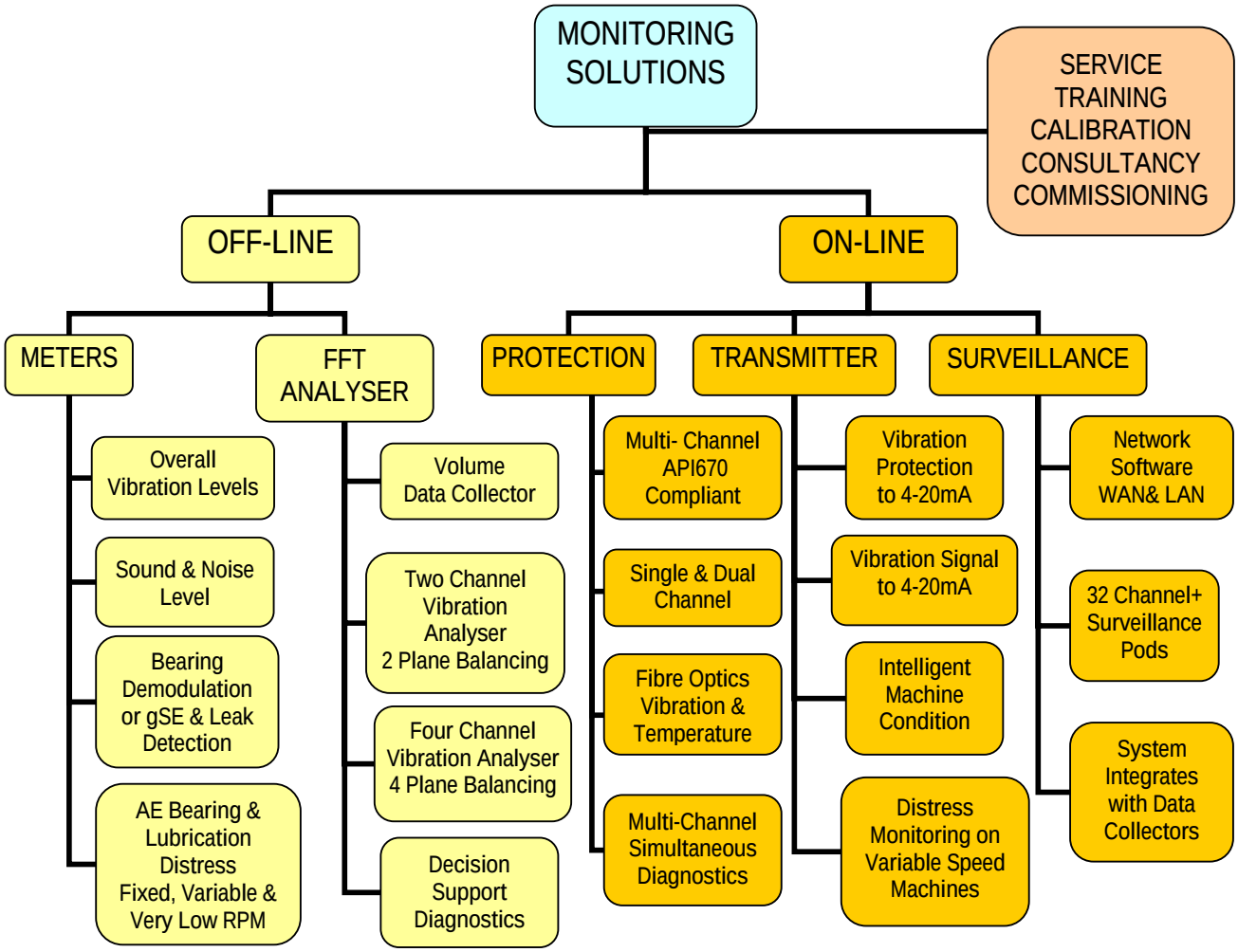
NSC RMA NUMBER ISSUED: RMA/

Taking you Further

14. Vibration Based Condition Monitoring Solutions

IRD Mechanalysis Ltd (IRD) is a leading provider of condition management solutions with 35 years' experience in machinery vibration measurement. IRD is credited with pioneering the concept of vibration based condition monitoring programmes in India. With the advent of computerization, IRD has established and maintained over 250 automated vibration based CM systems and has a user base of over 2200 major Producers and OEMs in India. IRD will continue to introduce new technologies to match your needs and reduce the cost of Condition Management. IRD is now rapidly expanding its International Export Division globally.

We take you further by providing reliable, easy to use, rugged and a comprehensive range of vibration monitoring products & solutions (as depicted in the chart given below) and enable you to enhance your productivity and investment. We look forward to your continued support and patronage.



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